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METALLURGIST

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THE EXPANSION OF STEEL PRODUCTION UNDER COMMUNISM

Translated from Metallurg, No. 9,
pp. 1-2, September, 1961

Metal is the main raw material of industry and without it there could be no development in production, material wealth or technical progress. It is therefore not by chance that metallurgy occupies one of the leading places in the economy of the country.

Since the first years of Soviet power,the Party and the Government have paid much attention to the development of this very important branch of industry.

We inherited from Tsarist Russia broken-down metallurgical plants with obsolete equipment. Meanwhile the country needed metal— metal with which to secure its defenses and develop its industries. Heavy industry had to be developed very quickly to form a firm basis for the dictatorship of the proletariat. In 1919 only 199 thousand tons of steel was smelted in this country. Immense effort was required on the part of the whole Soviet nation to considerably increase steel production in a short period. During the first 5-Year Plan the redesigning of existing plants and the construction of new metallurgical concerns increased the smelting of steel to 5.7 million tons in 1930. These years have gone down in the history of our country as years of heroic industrial effort. The new automobile, tractor and locomotive plants required unheard-of amounts of steel and iron. The powerful metallurgical giants arose one after the other: the Magnitogorsk and Kuznetsk Combines, "Zaporozhstal'," "Dneptrospetsstal'," "Azovstal'." The Soviet people labored valiantly to build these plants.

Foreign specialists invited to help in the construction work at that time simply could not understand our tremendous desire for great achievements. In 1940 the metallurgists gave the country 18.3 million tons of steel.

In 1941 the Second World War broke out. The country needed millions of tons of iron, steel and rolled stock. Many of the workers went to the front and their places were taken by women and young people. The whole of our industry was very quickly placed on a war footing and its geography changed considerably. Some of the plants were evacuated to the Urals from the temporarily occupied regions of the country. The work of the giant blast furnaces did not stop for a minute, the open-hearth flames thundered and the rolled stock issued in an endless stream. Shifts of 15-16 hr were worked. A tremendous battle was being waged for metal, a battle which was successful.

The war ended and men returned to the furnaces, donning their work clothes in place of their greatcoats. A period of development commenced. The country needed metal, but no longer for shells and tanks, not for rifles and machine guns, but for machine tools and machines, for tractors and combine harvesters, to restore and build new cities— the metal of peace.

The construction of the new industry forged ahead. In 1950 our metallurgical industry produced 27.3 million tons of steel, almost 10 million tons more than in 1940.

The years passed and new concerns appeared while technology was improved. Another decade passed in the intensive creative life of the Soviet nation. Heavy industry reached a high level of production— the production of steel in 1960 was 65.3 million tons.

Our metallurgy has certainly made tremendous strides. From year to year more iron ore is produced, our iron production being much greater than that of Britain, France and Belgium taken together. One increase alone in steel smelting in 1960 was 5.3 million tons— better than a million tons more than Tsarist Russian produced in 1913.

We have overtaken the USA not only with regard to the pace of development in ferrous metallurgy, but also with regard to the absolute increase in the main forms of its production. The average yearly increase in this production for 1958-1960 was 10.4% in this country and 2.6% in the USA.

The Communist Party and the Soviet Government, carrying out Lenin's policy of industrializing the country and laying emphasis on the development of heavy industry, are constantly striving to increase the production of metal. The metallurgists have a responsible task— to almost double the production of iron, steel and rolled stock during the 7-Year Plan. With tremendous enthusiasm the Soviet metallurgists are striving to successfully solve these problems and bring forward the completion of the 7-Year Plan. They are persistently searching for new internal reserves and are striving to give greater production with the least capital expenditure.

Assuming the complete fulfilment of the plan for the current year, in three years, due to the overfulfilling of the demands of the 7-Year Plan, we will have produced in addition almost 10 million tons of steel, about 8 million tons of rolled stock and more than 2 million tons of iron.

The volume of production in ferrous metallurgy in the Soviet Union closely approaches that in the USA. From January to May of this year in the USA, 20.9 million tons of iron was smelted and in the USSR during this period 20.8 million tons of iron was smelted and the total for the half year was 25 million tons.

From January to May of 1961, 32.9 million tons of steel was smelted in the USA and in the USSR during this period 29.2 million tons was smelted and the total for the half year was 34.9 million tons.

In the half year the Soviet Union has produced more iron and steel than Britain, France and West Germany taken together.

At the present time when the party has put forward for countrywide discussion the plan of the program of the Communist Party of the Soviet Union, it seems appropriate to consider past achievements.

Just-over 40 years have passed. Historically this period is quite short. But what successes our country has achieved during this period! The metallurgists of Tsarist Russia would never have dreamt that we would melt the metal for the world's first spaceships, that in 40 years we would leave far behind us many industrially developed countries, that we would literally be at the heels of the most highly developed capitalist country— the United States of America. The program includes the development of all branches of the national economy but, as previously, the dominating role will be played by heavy industry. "In the Soviet Union a first class heavy industry has been developed —written in the plan of the Program— the base of technical progress and economic power of the country. . . In the new period of development of the Soviet Union heavy industry should increase so that on the basis of technical progress there will be an increase in the branches of the national economy producing consumer goods in order to more completely satisfy the demands of the nation.

The main task of heavy industry is, therefore, to completely satisfy the needs for defense and to better satisfy the living requirements of the Soviet man."

This mainly concerns metallurgy, since metal is the raw material of our industry and without metal there can be no industry. Our metallurgists understand this perfectly. From year to year, from month to month, from day to day they are increasing the production of metal. Compared with the first half year of last year the following increases have been achieved: 2.1 million tons of iron, 2.8 million tons of steel, 2 million tons of rolled stock, 293 thousand tons of steel pipes and 5.9 million tons of iron ore.

As before, increasing the production of metal remains one of the most important economic problems. In 20 years our metallurgical industry will be able to melt about 250 million tons of steel per year.

The program for the first 10 years includes the development of engineering to provide complex mechanization in industry, agriculture, transport, etc.; and in 20 years there will be complex automation of production on a large scale with increasing use of automation in the plants.

In the near future the Magnitogorsk, Kuznetsk and Nizhni Tagil Combines and a number of metallurgical plants will be placed on an experimental basis with regard to the level of mechanization and automation. The labor productivity here will be increased by 50-60% and there will be no heavy manual operations whatsoever. For this purpose 84 organizations should do work on more than 50 scientific research projects, requiring basically new technical solutions.

The development of Communism requires a more rational arrangement of industry, which will provide economies in general labor, development in the regions and specialization of their economy.

In the next 20 years a third of the country's metallurgy will be built in Siberia. The West Siberian Metallurgical Combine and the Karagandinsk Metallurgical Plant will soon be in operation. In the first 10 years the country will obtain millions of tons of metal smelted at the newly built concerns.

The party has always cooperated and will continue to cooperate in the further intensification of the role of science in the building of a Communist society. The party recognizes the need for cooperation between scientists and engineers. Science should become a direct production force.

Our scientific research institutes and planning organizations are constantly seeking new possibilities for the development of production forces.

Thus, VNIIMETMASh is finishing the planning of a continuous medium-section 400 mill for specially thin-walled shaped profiles. This mill will roll 1.8 million tons of metal per year.

The Central Laboratory of Automation in the Ministry of Construction for the Russian Soviet Federal Socialist Republic has developed a system of numerical running control. The instruments can continuously measure and print 44 indices for the blast furnace process. No one even has to process the data obtained from the instruments, this is done by the machines themselves.

At the Krivoi Rog Plant the largest blast furnace is now operating. In the planning organizations a plan is now being developed for a still greater giant—a blast furnace with useful volume of better than 2000 m^3.

The construction of an automated 1300 blooming mill will soon be completed at the Urals heavy engineering plant. It will be able to handle several million tons of metal per year. At the blooming mill they will use computers and many mechanisms to help the workers. Scrap, scale and metal cutting will be loaded into cars without the need for labor on the part of the workers.

Constant improvement in the technology of all branches and forms of production is an essential condition for the development of industry. At many sections of production Soviet metallurgists have achieved extremely good results, easily overtaking their most serious competitors—the metallurgists of the USA. For example, the coefficient of utilization of useful volume for the whole of the USSR is 0.75 and in the USA it is about unity. In other words, Soviet blast furnace workers obtain 1340 kg of iron per day from each cubic meter of useful volume and the Americans obtain 1000 kg. This index is still higher in the blast furnaces of the Magnitogorsk Combine and the Cherepovets plant. Soviet steel smelters obtain 25% more metal from 1 m^2 of hearth area.

The main economic problem of the party and the Soviet people is to build a material and technical base for Communism within 20 years. An important part will be played by Soviet metallurgists, since the "further rapid increase in production of metal and fuel, forming the basis of modern industry, will still be one of the most important economic problems." Experience has shown that our metallurgists are not dismayed by difficulties. There is no doubt that they will apply all their energies, knowledge and experience during the coming years to achieve the best indices in the world for the production of metal.

ELIMINATING PULSATING BURNING IN AIR HEATERS

Senior Production Foreman, I. L. Kolesnik and

Head of the Technological Group, Yu. F. Yashin

Dzerzhinskii Plant

Translated from Metallurg, No. 9,
pp. 3-4, September, 1961

During heating the existing air heaters of blast furnaces equipped with IZTM and UZTM burners (Fig. 1) cause pulsating combustion of the gas, which leads to vibrations in the fan of the burners and the whole equipment, including the housing of the air heater itself. As a result the combustion chamber of the air heater housing is broken, the charge and the tripoli brick are blown out and the air pipe of the hot blast is also broken. The pulsating combustion of the gas and the presence of vibration also leads to a reduction in the gas loads on the burner and consequently to a reduction in the thermal power of the air heaters, the temperature of the blast and to an increase in the coke consumption per ton of iron.

With the use of natural gas in blast furnaces the temperature of the blast becomes a main factor in the possible further increase in the consumption of natural gas and reduction in the coke consumption, since the use of natural gas cools the hearths and very hot blast must be used to compensate the temperature in the hearth.

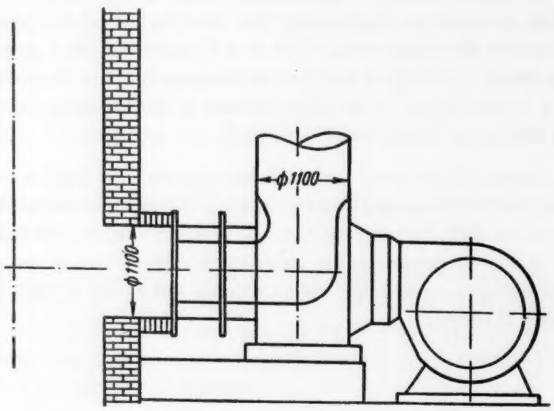

Fig. 1. Gas burners used at the plants.

The pulsation of combustion of blast-furnace gas in the burners arose because the temperature of the blast had to be increased, which in its turn led to an increase in the gas and air loads at the burner.

At our plant we have been dealing with the problem of formation and removal of pulsating combustion of the gas since 1957. To eliminate pulsations we used an additional ignition flame for the coke gas, turbulent feed of the gas using a screw and also widening of the connection pipe of the air heater at the expense of the lining of the connecting pipe, partial feed of air within the gas nozzle, changing the through cross sections of the gas and air circuits of the burner, etc.

However, even with all these measures favorable results were not obtained. In our opinion at the existing burners the pulsation in the burning of the gas is due to the following factor. The design features of the gas burners are such that at the outlet from the burners a fuel mixture is formed which begins to ignite and burn in the connecting pipe of the air heater, forming a short flame. Due to the sharp increase in volume this flame affects the uniform

feed of air by the fan, as a result of which the air feed is agitated, leading to agitation in the combustion products, i.e., in certain periods of time different amounts of combustion products pass through the transverse cross section of the chamber. With two operating air heaters with different degrees of pulsation of combustion this sets up a resonance in the flue and increases the vibration of the equipment. All these irregularities are due to the incorrect combustion of the blast furnace gas; the combustion chamber does not completely fulfil its function and a part of the functions of the combustion chamber are fulfilled by the connecting pipe of the air heater.

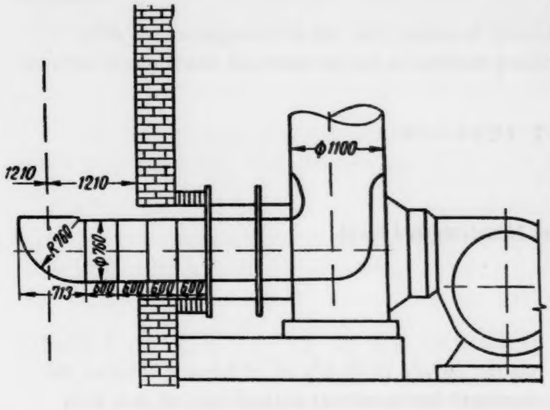

Fig. 2. A continuation of the gas circuit of the burner inside the combustion chamber.

On May 5, 1961 during the repair of the No. 11 blast furnace in line with our suggestion,at the No. 2 air heater the gas and air were fed separately within the combustion chamber in order to ensure its complete use for burning the gas over the whole height, which made it possible to eliminate ignition and partial combustion of the blast-furnace gas in the connecting pipe of the air heater. For this purpose the gas circuit of the burner inside the combustion chamber was prolonged with the gas directed upwards (Fig. 2).

For convenience in assembling,the insert was made of five sections; the last of them was in the form of an elbow to direct the gas upwards. The construction of the insert (gas nozzle) of sections is dictated by the small distance between the connecting pipe and the burner. The sections are connected by rings and welding (Fig. 3). Supports are used to instal and center the insert (gas nozzle) (Fig. 3).

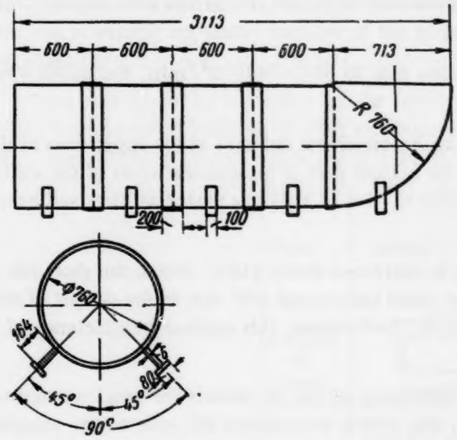

Fig. 3. Installation and centering of insert by means of supports.

Before installation of the gas nozzle the No. 2 air heater operated on limiting loads within the limits of permissible vibration and the gas and air flow was 28-33 thousand m^3/hr with the load on the fan motor of 100 a. Further increase in the gas flow resulted in undue vibration.

After installation of the gas nozzle the No. 2 air heater operated with 49,000 m^3/hr of gas and air flow with 150 a load on the fan motor. Using a gas nozzle to burn the gas has eliminated pulsations in the gas combustion. The operation of the fan became steady and this eliminated the agitated feed of air to the burner and hence the vibration in the equipment. Increasing the gas load to the burner above 50,000 m^3/hr is limited by the power of the fan motor and not by the pulsation of the gas combustion.

The test gave the following data:

Period of heating	I	II
Temperature of crown, °C	1000	1150
Pressure of air at fan, mm water colum	360	280
Content in flue gas, %		
CO_2	24	20
O_2	0.8	4
CO	None	None

After the air period the temperature of the crown increases much more rapidly than before this period. By eliminating the pulsations of combustion at all air heaters of the blast-furnace department it is possible to sharply

increase their thermal power, raise the temperature of the blast, reduce the coke consumption per ton of iron, increase the flow of natural gas and prolong the life of the air heaters and their equipment.

At the Dzerzhinskii Plant all the air heaters of the blast furnaces now have gas nozzles for separate feed of gas and air to the combustion chamber.

INSTALLING AIR HEATERS IN A LARGE BLAST FURNACE

Yu. A. Vinogradov

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Translated from Metallurg. No. 9,
p. 5, September, 1961

The air heaters of the Komsomol blast furnace have a heating surface of 63 m^2/m^3 of furnace volume, the burners are equipped with fans delivering 48,000 m^3/hr, the checkered brickwork has cells of 45 × 45 mm with 40 mm thick bricks. The heating of the crown of the air heaters was limited to a temperature of 1150°. At the present time it is 1200°.

Immediately after blowing the furnace the duration of the air period was 2 hr with a 6 hr gas period. The temperature of the flue gases at the end of the gas period was then extremely high. So that the temperature of the flue gases did not exceed 400° the gas flow had to be artificially reduced to 20,000 m^3/hr and even lower. Only about 30% of the power of the burners was used.

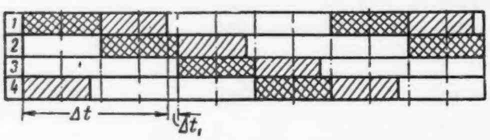
When the blast temperature was increased to 950° and its flow rate to 3300-3400 m^3/min, the mixer was closed within 2 hr after changing over the air heaters.

To increase the blast temperature the temperature of the air heater crown and that of the upper rows of the checkerworks was increased by reducing the excess air, heating the bottom part of the checkerworks of the air heater more strongly by burning a larger quantity of gas,and also by changing over to a shorter period of blast and heating of the air heaters.

The temperature of the crown of the air heaters could not be increased above 1150° due to the short life of the crown and checkerwork brick. The temperature of the flue gases could not exceed 400° due to the danger of overheating the grating and columns of the space near the checkerworks; furthermore, this spoiled the efficiency of the air heaters.

To increase the temperature of the blast and improve the efficiency of the air heaters the usual recommendation is to change over to shorter blast and gas periods. However, this system accelerates the wear on the equipment of the air heaters, increases the number of blows from the blast during the changeover and takes up much of the gasfitter's time in changing over the air heaters.

The gas fitters of the Komsomol furnace have suggested and installed a new system of air heater operation, when simultaneously only two air heaters are heated and the other two are on "blast." The figure shows the operation of the air heaters. Changing over to the new system of operation will be effective when there is a considerable reserve in the rate of heating of the air heaters or four air heaters.



New graph of operation of air heaters (heating the blast through two air heaters): □– gas period of air heaters; ▨– air period– colder air heater; ▩– the same, hotter air heater; Δt– 200-225 min; Δt_1– 20-25 min.

Due to the introduction of this type of operation of the air heaters the blast temperature was increased to 1000° (it is now 1050°) and at the same time there was some improvement in the efficiency of the air heaters (with the usual system for changeover of the air heaters using a higher blast temperature the efficiency is reduced).

When the blast is applied to the next air heater the gate valve of the cold blast is first half opened,and then when the mixer is closed it is completely opened. With subsequent closing of the mixer the gate valve of the cold blast at the colder air heater is half closed, etc. It is theoretically possible to operate with a complete closed mixer and the mixer has to be used when there is a sharp drop in the blast temperature; a higher value of efficiency is then obtained.

With the changeover to the new system of operation of the air heaters the gas flow to the block of air heaters remains constant and the consumption of electric power is reduced somewhat.

DESIGN OF THE PARTS OF AN ORE GRAB

L. N. Gorodetskii, Mechanical Engineer in the Petrovsk Works

Translated from Metallurg, No. 9,
p. 6, September, 1961

The operation of Starokramatorsk Ordzhonikidz factory grabs in the Petrovsk works showed that their maintenance was relatively expensive because of the large consumption of bronze and the low stability of the connecting cable (Fig. 1).

Tests carried out by the author on the substitution of the expensive bronze bushing of the pulley block by bimetallic (two layered) bushings of steel and bronze gave completely satisfactory results. With a bronze layer of width 7 mm, 60 kg of bronze was saved in each set.

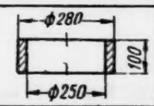
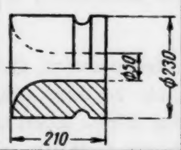
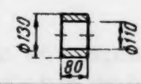
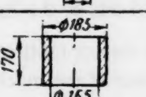
Part	Sketch of part	No. of parts in one grab of samples	Material	Wt. of set in one grab	Durability in days
Bushing of block		9	Br Azh-9-4	90	150-180
Guide bushing		2	Br Azh-9-4	34	10-15
Bushing of jaw joints		8	O TsS-5-5-5	20.8	150-180
		4	Br Azh-9-4	30.4	

Fig. 1. Amount and durability of bronze parts in grab.

The bushings of the jaws and levers should also be made of bimetallic layers with a layer of bronze of 2-3 mm.

The life of the guide barrels of the connecting cable even when the wear due to the number of slots (Fig. 2) is the most favorable (because the barrel is controlled spontaneously) does not exceed 10-15 days. The abrasive medium and the presence of the slots in the barrel in which the connecting cable slides, significantly reduce the durability of the latter. Under the conditions of the Petrovsk factory blast-furnace plants the average useful life of the connecting cable is three months.

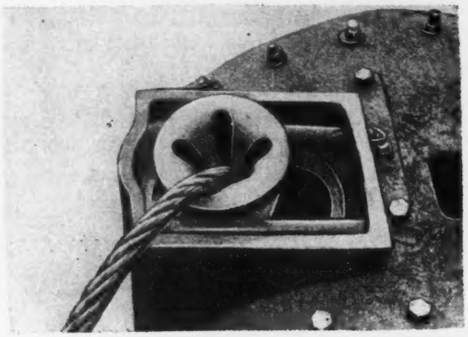


Fig. 2. Typical picture of the wear of a bronze guiding cable.

Observation on the operation of different guide rollers showed that it is quite reasonable to substitute the bronze barrel by guide rollers of steel,which was suggested by the VNIIPTMASh (All-Union Scientific Research Institute of Hoisting and Conveying Machinery) for grabs of the type having an analogous capacity and purpose. As a result of this kind of substitution, more than 1000 kg of BrAzh-9-4 will be saved in a year for each grab and the operating conditions of the connecting cable of the grab will be improved. It is necessary to note that the tests carried out on the substitution of bronze guide barrels with barrels of graphitized steel,although reducing the consumption of bronze did not give conditions where the cable could be operated normally.

IMPROVEMENT IN THE DESIGN OF JUNCTIONS AND PARTS OF POURING MACHINES

V. F. Pashinskii

Makeevskii Metallurgical Factory
Translated from Metallurg, No. 9, pp. 6-7, September, 1961

In the operation of pouring machines from the Irkutsk factory it was shown that the individual junctions and parts did not satisfy the claims made for the machines; the productivity of the machines was reduced and the maintenance and handling were hampered.

One of these parts is the links of the conveyer. In the operation, the levers to which the molds are fastened rapidly wear out and are buckled, which leads to the molds breaking away frequently, producing flaws in them. A reduction in the number of worn-out links by the welding of new levers is not advantageous, because this method will not give the required durability. To ensure the necessary durability,instead of two levers,one is welded over the whole length of the link.

Operation showed that it was also advantageous to strengthen the links by welding the steel plate and also links not yet used (Fig. 3). This considerably increases the useful life of the link (approximately by 2.5-3 times).

Another shortcoming in the design of the machine is the unpractical disposition of the drains and pipes for the discharge of water. The effluent drain from behind the cones of the machine and the drain which removes the water cooling the iron in the wagons are placed in a straight line (Fig. 4a). The drain discharging the cooling water used for the iron has a larger slope than the drain from under the cones and the amount of the water escaping is significantly greater; consequently, the water from under the cones escapes extremely slowly. This leads to the fact that

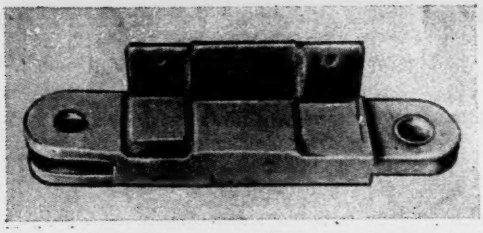


Fig. 3. Link of conveyer of pouring machine after strengthening.

fine particles of dirt, lime and scale are not removed, but are deposited and the removal of the cones is made very difficult. As a result of the poor discharge, the water from the drain escapes and pours over the whole of the basin. With a small sag in the belt the molds enter the water, which leads to additional losses of iron due to spattering.

The water cooling the iron on the conveyer also favors an unsatisfactory discharge, since it is discharged into a drain which diverts the water under the cones (Fig. 4a). Because the level of water under the cones is raised, the lower edge

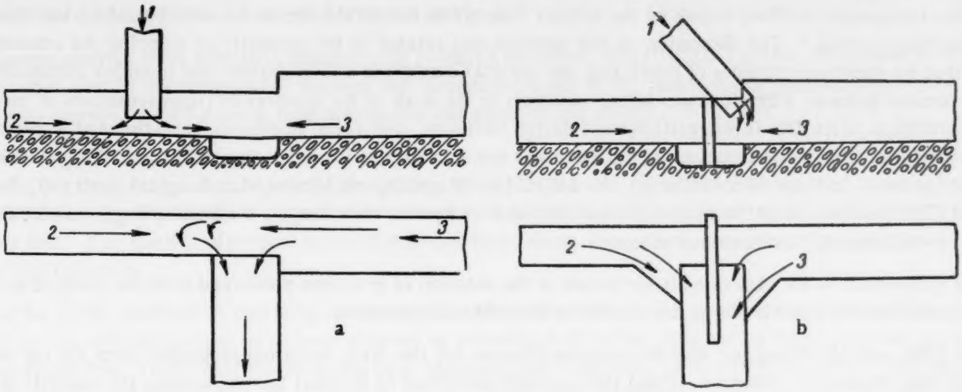


Fig. 4. Effluent drain before (a) and after (b) rebuilding. 1) Water from the top of the belt; 2) from under the cones; 3) water from under the iron pouring in the wagons.

of the pipe discharging the water from the belt is lower than the level. Due to this, the velocity of the effluent water along the pipe is reduced, which assists in the rapid deposition of the lime on the walls. The cleaning of the tube is required to be carried out once in 7-8 months.

To eliminate this phenomena the position for the effluent drains to meet was decided on and a separating concrete plate installed which controlled the effluent water in the general drain without its mixing (Fig. 4b). Moreover, the pipe diverting the water from the top of the conveyer was removed from under the cones. This led to a considerable improvement in the discharge of water from under the cones, which significantly facilitated the operation of the pouring machine.

PREDICTION OF THE THERMAL CONDITIONS OF A BLAST FURNACE DURING SMELTING

L. A. Byalyi and I. P. Yudin

Translated from Metallurg, No. 9,
p. 8, September, 1916

In March, 1961 the Central Office of Technical Information of the Chelyabinsk Council of National Economy, the Chelyabinsk NIIM and the regional member of the NTO (Scientific and Technical Division) of ferrous metallurgy organized a symposium in Chelyabinsk on the subject "the prediction of the thermal conditions of a blast furnace during the smelting process." The discussion on this problem was related to the necessity of reducing the content of Si and S in iron by improved methods of predicting the thermal conditions and by further and complex automation of the blast-furnace process. Fifty four specialists took part in the work of the symposium (representatives of metallurgical undertakings, scientific investigational and design institutes, managers, engineers, scientists and workers). Reports were heard from representatives of the institutes and factories of the following: NIIM (the Chelyabinsk Scientific investigational institute of metallurgy), the MGMI (the Magnitogorsk Mining Metallurgical Institute), the TsNIIChM (The Central Scientific Investigational Institute of Ferrous Metallurgy), the Nizhni Tagil and the Orsk-Khalilovo Metallurgical Combines and others.

The symposium dealt with three basic trends in the solution of problems concerned with the prediction of the thermal conditions and automation in the control of blast-furnace processes.

The NIIM and MGMI suggest that the relation between all the main operating properties from the top and bottom of the blast furnace be obtained, taking into account the effect of thermal inertia, because the analysis of blast-furnace gas alone, just like any properties calculated from the results of this analysis, cannot define the operating conditions in the top of the furnace as well as the degree of thermal and chemical conversion of the charge materials in this part of the furnace. The trend of the work carried out in the NTMK is to make the automation of the blast-furnace process possible under furnace operating conditions with a charge having relatively constant physicochemical properties. It is suggested that the control signals used should be the pressure drop between the upper and lower parts of the furnace and the heat balance: chemical, determined by the difference between the calorific value of the gas in the region of the tuyeres and at the throat, and physical, determined by the temperature and the amount of blast-furnace gas. Moreover, the control of operation is completed in the plant by controlling and maintaining a constant supply of air from the tuyeres as one of the automation elements of the blast-furnace process. The third trend is being developed by TsNIIChM– which is to confirm the suitability of calculated parameters for the purpose of the automation of the blast-furnace process, established by the LPI, the Steel Institute and other organizations. This is confirmed with the aid of contemporary computer techniques on furnaces which are working.

During the discussion it was noted that coordination and an extensive exchange of information was required in all work related to the prediction and automatic control of the thermal conditions of the blast furnace. It was resolved to pay the utmost regard to further investigations into the blast-furnace process in furnaces actually operating, with the aim of subsequently using all the principles established in the furnace process to predict the thermal conditions.

The participants of the symposium suggested that in order to carry out a detailed investigation into the operation of present-day blast furnaces-combined teams of workers should be set up (based on the pattern of the team directed by Academician M. A. Pavlov).

The symposium emphasized that the basis for a further improvement in the operation and the establishment of constant thermal conditions in blast furnaces is to improve the quality of the raw materials, which will also considerably facilitate the realization of complex automation of the blast-furnace process.

CONFERENCE ON THE DIRECT EXTRACTION OF IRON FROM ITS ORES

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p. 9, September, 1961

During 16-19 May of this year in the I. P. Bardin Central Scientific Research Institute for Ferrous Metallurgy, a scientific coordination conference was held which was devoted to the problem of the direct extraction of iron and steel from ores without the use of the blast furnace or of coke.

Representatives from scientific research and planning institutes, metallurgical plants, and councils of national economy took part in the conference. Reports and communications on the research and planning work done were given by 29 persons, and 38 persons took part in the discussion of the reports.

The direct extraction of iron from ore has now emerged from the patent stage into industry. The use of iron powder for the preparation of metal-ceramic articles, in welding, in the chemical industry, and in other branches of the national economy is widely known. The iron powder is obtained by the direct reduction of rich ore or other oxides or iron. The quality of several types of steel produced using sponge iron formed by the reduction of ore is appreciably improved.

In the USSR, methods of obtaining sponge iron for the production of iron powder in revolving-drum furnaces and also an ore refining process have been adopted on a commercial scale. Reports on these processes were given by representatives from TsNIIChM, the Orsk-Khalilov Metallurgical Combine, Giprostal', Gipronikel', the Institute of Metal-Ceramics, and the special alloys section of the Acad. Sci. USSR. Technical-economic research must be conducted to determine the efficiency of the processes for the direct extraction of iron under the varied economic conditions in our country. In view of the wide variety of these conditions, those regions where it is most expedient to introduce the processes already adopted should be determined.

Reports on new research and planning work were given at the conference by workers from the Institute for the Utilization of Gas of the Acad. Sci. USSR, Ukrgipromez, VNIIMT (Sverdlovsk), Gintzvetmet, Mekhanobrchermet, the plant "Sibelectrostal'" and other organizations. At the conference the necessity for accelerating the planning and construction of semicommercial and experimental-commercial installations to investigate and adopt the processes worked out was noted.

Up to the present time, the processes worked out for the direct extraction of iron are not large metallurgical processes; in plant productivity, they cannot compete with the existing two-stage metallurgical reduction with the blast furnace and steel melting furnace. Therefore, as was noted at the conference, the main line of research should be directed toward working out new, highly productive and economical processes utilizing the latest achievements in science and technology.

The reports at the conference noted the lack of coordination in the work being done; this results in delay in conducting research and planning and sometimes in unnecessary duplication. The conference recommended that a section for problems in the direct extraction of iron be organized in the coordination council for ferrous metallurgy of TsNIIChM. This council would develop the essential directions of the research, review the completed scientific research and planning work and make recommendations on it, and prepare for the construction of experimental installations.

RAPID METHODS OF REPAIRING AND FETTLING A NEW FLOOR

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Nizhni Tagil Metallurgical Combine
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Curtailment of the standstills of the open-hearth furnace during floor repairs is one of the factors which increase furnace productivity. Time lost in furnaces undergoing floor repairs in our combine from 1956 through 1960 has been reduced 2.7 times; this is equivalent to an increase in furnace output by calendar time of 1.6-2.0%. Standstills of furnaces while burning-in new fettling after major overhauls have also been appreciably shortened.

We achieved such successes by introducing a new technology for burning-in fettling, increasing the period of its service between repairs, improving the profile of the hearth and the maintenance of the steel tap holes, using a more suitable slag regime, and so on. The achievements were also promoted by the conversion of the furnaces to basic refractories, the use of oxygen and compressed air, the installation of thermal insulation of the arches and other elements of brick refractory, perfection of the smelting process, etc.

Causes of Low Floor Durability

Magnesite powder containing 85-93% MgO, up to 3% CaO, and up to 4.2% SiO_2 is used for fettling.

Manganese oxide has a very high melting temperature (2800°), and it is therefore impossible to weld the magnesite powder into a monolithic mass. In order to obtain a highly refractory and monolithic sinter, it was the practice until recently to add open-hearth slag (up to 15-18%), and less often mill dross, to the magnesite powder.

Analysis of the results of the service of floors burned-in with the use of large quantities of slag has shown that, although the floor becomes solid, it is not very refractory or impermeable to slag and quickly gets out of order.

The wear of the floor and the formation of depressions in it are explained by the fact that during the service period, the floor becomes covered with silicates and iron oxides with the formation in the fused layers of many unrefractory or unstable minerals such as montechellite, merwinite, and double-calcium silicates. Depressions form in the floor wherever these minerals are locally concentrated, and if there is a general concentration of them, this leads to premature deterioration of the entire floor.

Practice shows that the floor does not have the necessary durability if slag remains in the furnace after the heat is tapped. The undissolved reducing agents remaining also lead to local concentrations of silicates in the floor and the formation of depressions. An uneven hearth profile leads to an accumulation of pools of slag and the formation of depressions.

Sharp cooling of the floor during hot or cold repairs of the furnaces contributes to faster deterioration, if the floor is not covered during this time with loose charge materials.

The experience of the NTMC and other plants has shown that during the burning-in of a floor with thick layers of magnesite powder (firing of the layers is continued for 1.0-1.5 hr followed by slagging with dross), a sufficiently strong, highly refractory crust about 15-25 mm thick is formed on the surface of the floor. This crust protects the magnesite powder which is still unsintered (although moistened with dross) from floating and disrupting the fettling. Further formation of the floor proceeds evenly during the melting of the metal (basically due to its saturation with iron oxides and other components of the liquid slag). During this time the fettling consolidates and forms a continuous monolith.

In order to obtain good floor durability, it is very important that the following conditions be met:

a) provide good and even slagging of the floor masonry before fettling;

b) do not allow the formation of pools of slag after slagging the floor (excess slag should be removed and the depressed area smoothed out with dry magnesite powder);

c) blow out slag residues and remove "dams" in front of the tap hole quickly without cooling the working space of the furnace;

d) do not allow mechanical injury of the floor during charging, especially during the first heats;

e) do not permit slag to remain on the floor after the heat is tapped;

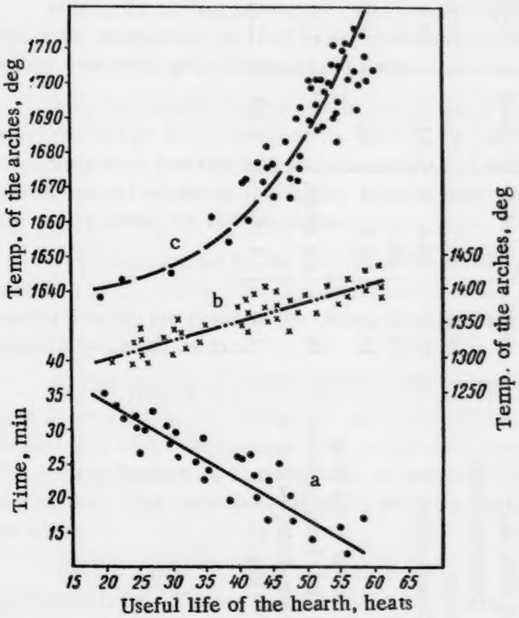
f) charge loose material from the distant charging window toward the center of the furnace, thus forcing residues of metal and slag toward the steel tap hole;

g) keep the steel tap hole its normal shape and size;

h) prevent sharp cooling of the floor during cold and hot repairs of the furnace by covering it with a thick layer of loose materials.

Current Repair of the Floor

It is necessary to make ready for the repair beforehand in order that the floor may be cleaned quickly and efficiently of slag and metal. Several heats before the repair the tap hole is exposed, mounds on the floor are evened out, and the necessary materials and instruments are made ready. During the last heat before repair, a well-fused, fluid slag is specially prepared, and the heat is tapped, as a rule, without preliminary deoxidation in the furnace with ferrosilicon. This contributes to good removal of the slag from the furnace. The floor is cleaned of residues of slag and metal with oxygen or compressed air which is blown in at a pressure of 5-6 atm through two or three pipes with heat resistant adaptors.



The dependence of the life of the floor on the temperature regime during repairs.

Rapid and efficient cleaning of the floor has a singularly important implication, since if this is not done, aside from the loss of time, the working space will undergo considerable cooling, which also lowers the durability of the floor.

From the figure it is evident that the faster the cleaning of the floor, the better the durability (curve a).

The cleaning of the furnace should be completed at a high furnace temperature; the higher the temperature of the arches and, consequently, the working space after the floor is cleaned, the better the service of the floor (curve b).

After cleaning the floor, the furnace is fired for 10-15 min, after which a steel worker and his second helper add magnesite powder to the gas using a charging machine and baffle plate; this ensures good welding of the materials to the old sinter. The layer is fired for 20-30 min at the maximum thermal regime, and then the slopes at the ends and the forward and back walls are repaired. The profile of the hearth is evened out if necessary, and the steel tap hole is covered with a mixture of magnesite powder and dross. After these operations are completed, the layer of new fettling is fired 1.0-1.5 hr more at the highest possible furnace temperature (figure, curve c).

After firing is accomplished, the layer being fused is slagged with dross until the appearance of puddles of slag on the floor; the steel tap hole is then opened, the residue of slag is removed, and charging begins.

Comparison of the Results of the Old and New Methods of Fettling New Floors

Item	Old method of fettling				New method of fettling				
	single-trough furnace		double-trough furnace		single-trough furnace			double-trough furnace	
	furnace A	furnace B	furnace C	furnace D	furnace D	furnace F	furnace G	furnace H	furnace I
Number of layers	11	12	13	14	2	4	3	4	4
Total length of fettling, hr-min	75-00	72-10	91-25	147-25	24-00	36-20	28-20	29-47	44-00
Including:									
length of the first slagging	11-57	15-55	11-45	21-55	6-50	9-25	7-30	9-05	9-20
length of fettling proper	60-18	58-15	75-20	118-25	14-15	24-50	18-45	27-25	31-00
length of second slagging	2-45	3-00	4-20	7-05	2-55	2-05	2-05	3-17	3-40
Average time of firing each layer	5-29	3-54	5-46	8-27	7-08	6-13	6-14	6-46	7-35
Quantity of materials consumed, tons:									
magnesite powder	28.8	34.1	76.3	57.0	33.4	32.5	32.5	40.2	43.0
ground open-hearth slag	28.2	29.4	60.2	63.5	65.0	30.5	15.9	35.8	31.3
lump slag	14.0	12.0	–	–	–	11.9	25.0	–	–
dross	10.5	5.2	12.8	16.6	33.5	21.3	21.0	33.6	61.0
Length of the service period of the floor until the first repair after fettling, heats	14	not deter.	9	11	67	36	21	35	52
Time lost in floor repairs during half of a year after the new fettling, %	1.7	3.58	1. 8	1.53	1.08	0.77	1.37	0.59	0.67

All in all, such a repair takes 2.5-3.5 hr, and the durability of the floor until the next repair reaches 45-55 heats.

Fettling a New Floor

A rapid method of fettling floors after a major overhaul has been introduced in the open-hearth plants of the NTMC. Seven floors have already been done by this method.

The method is essentially the following. After the furnace is fired to a temperature of 1650° (when the temperature of the floor masonry has hardly increased during the last 8 hr), slagging of the brick masonry with ground (or lump) open-hearth slag is begun in order to fill up the seams. The excess slag is then removed with compressed air, and the fettling of the floor with magnesite powder begins; this is done, as a rule, in 3-4 layers (instead of 11-14 layers as previously) which are calculated to provide a total thickness of 200-220 mm. The first layer, 15-25 mm thick, consists of magnesite powder without slag or dross; the second and third layers, 20-35 mm thick, are applied to the floors, the slopes at the front and back walls, and also at the ends with the addition to the magnesite powder of about 12% ground slag and 3-4% clear dross (percentages of the weight of the entire mixture).

During the intervals between successive applications of the basic layers, small intermediate layers are applied to the slopes at the front and back walls, at the ends, and along the joints in order to create the necessary hearth profile.

After the next to the last layer is well baked, a mixture of ground open-hearth slag and dross (60 and 40%) is thrown on the floor and slopes. The last layer of magnesite powder, about 130-150 mm thick, is spread with the charging machine and baffle plate and requires up to 24-28 tons of magnesite powder. The hearth profile is formed at the same time. This layer is fired for 4-6 hr. The floor is then slagged with dross for a period of 2.0-3.5 hr.

During the fettling period, the temperature of the arches is maintained within the limits of 1690-1710°; reduction of the temperature to 1650° is permitted only during the periods of charging materials into the furnace. This regime provides a good fettling of the floor.

After the floor is slagged and the excess slag is removed, charging of the first heat is begun; at the present time, this charge is calculated on the basis of the usual weight and prepared with molten pig iron (formerly, the first three heats were prepared with reduced weight and with cold pig iron). The previously used method usually did not provide normal release of slag during the heat, and the new floor and slopes were strongly eroded by the large quantity of slag during the melting period.

The time required for the first heats after fettling the floor by the new method was 1.5-2.0 hr shorter than predicted by the charts. The consumption of materials in fettling the floor and the length of individual operations on various furnaces are shown in the table. The total time required to fettle a new floor is 24-44 hr instead of 72-147 hr required by the old method.

In 1960 fettling of a new floor in one of the large capacity furnaces was accomplished in 32 hr 30 min; it was done in three layers and without the use of open-hearth slag. The floor masonry and the magnesite fettling were slagged only with dross having a total weight of 83.0 tons; the consumption of magnesite powder amounted to 50 tons. The fettling proper took 21 hr 50 min, as compared with 27.5-31 hr on other large capacity furnaces fettled by the new method. The materials, including the dross, were fed into the furnace with the charging machine using the baffle plate.

The floor lasted 63 heats until the first repair. After the repair, which lasted 3 hr 20 min, the floor served for another 42 heats. The latest repair took 3 hr 25 min. At the present time the furnace is operating normally.

There is reason to suppose that the last variation of the new method of fettling will prove quite effective.

The experience in the operation of the open-hearth furnaces of the NTMC has confirmed the expediency of conducting the fettling of new and the repair of old floors by the rapid method—in thick layers and with the use of large quantities of clear mill dross. This method should find wide use at other plants.

LARGE-UNIT INSTALLATION OF THE SUPERSTRUCTURE OF THE OPEN-HEARTH FURNACE WITH ITS REFRACTORY MASONRY USING A METHOD OF MOUNTING

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In major overhauls of open-hearth furnaces during recent years, wide use has been made of a method of large-unit installation of the metal structure. The metal structure has been erected in individual units weighing from 20 to 100 tons, depending on the location of the plant and its equipment with overhead electric cranes.

In 1952 in the "Uraldomnaremont" combine a highly efficient method of installation was worked out and put into operation,which consists in mounting the superstructure of the furnace assembled in one consolidated block. By this method the metal structure and the masonry of the superstructure are assembled in one consolidated block in the teeming bay before the furnace is shut down, and after the old furnace has been disassembled it is moved by the plant's cranes and placed on a temporary stand alongside the furnace and is then mounted on its foundation by mounting winches.

The method of large-unit installation was perfected over a period of many years and has been used on almost all of the major overhauls and reconstructions of the open-hearth furnaces, including the large-capacity ones for which the weight of the consolidated block reaches 500-550 tons. Such a block is moved and stood on the temporary foundation by two overhead cranes with a load capacity of 260 tons each.

All of the metal structure and masonry units of the superstructure of the furnace together with framework for the ends, the entire water delivery and drain system for cooling the furnace, and the suspension casing for the main arch are incorporated into the consolidated block. The block is moved on rails laid on the temporary stand and on plates on the furnace abutments which are lubricated with a graphite grease.

A rapid method of mounting the consolidated blocks of the metal structure together with the refractory masonry, introduced in 1960 by the "Uraldomnaremont" combine in the metallurgical plants of the Urals for the first time in the construction and repair practice of the Soviet Union, is a new stage in the development of large-unit installation in major overhauls of open-hearth furnaces.

Into the consolidated block are incorporated all of the metal structure and masonry of the superstructure of the furnace together with the ends, the evaporative cooling system, and the refractory masonry of the floor, slopes, front and back walls, ends, and main arch with a suspension device and casing. The total weight of the consolidated block of metal structure with the refractory masonry is from 800 to 1700 tons,depending on the capacity of the furnace.

Before the furnace is stopped for repair, the consolidated block is assembled in the teeming bay along the furnace axis on a specially built stand consisting of a sand cushion, metal bottom-plates, rail piles, and girders of welded metal pipe or beams on top of which is laid a sheet 30 mm thick. Steel rollers 100 mm in diameter are laid out on the sheet; sheets 800 mm wide and 20 mm thick on which the consolidated block is moved by rollers are welded from below onto the main longitudinal beams of the platform.

After the metal structure has been assembled, the refractory masonry is laid up with reinforcement for the face of the main arch and protection for the casing during the entire period of transfer.

After the old furnace is disassembled, a temporary foundation consisting of metal pipes and beams (analogous to the assembly stand) is set up between the stand and the furnace foundation.

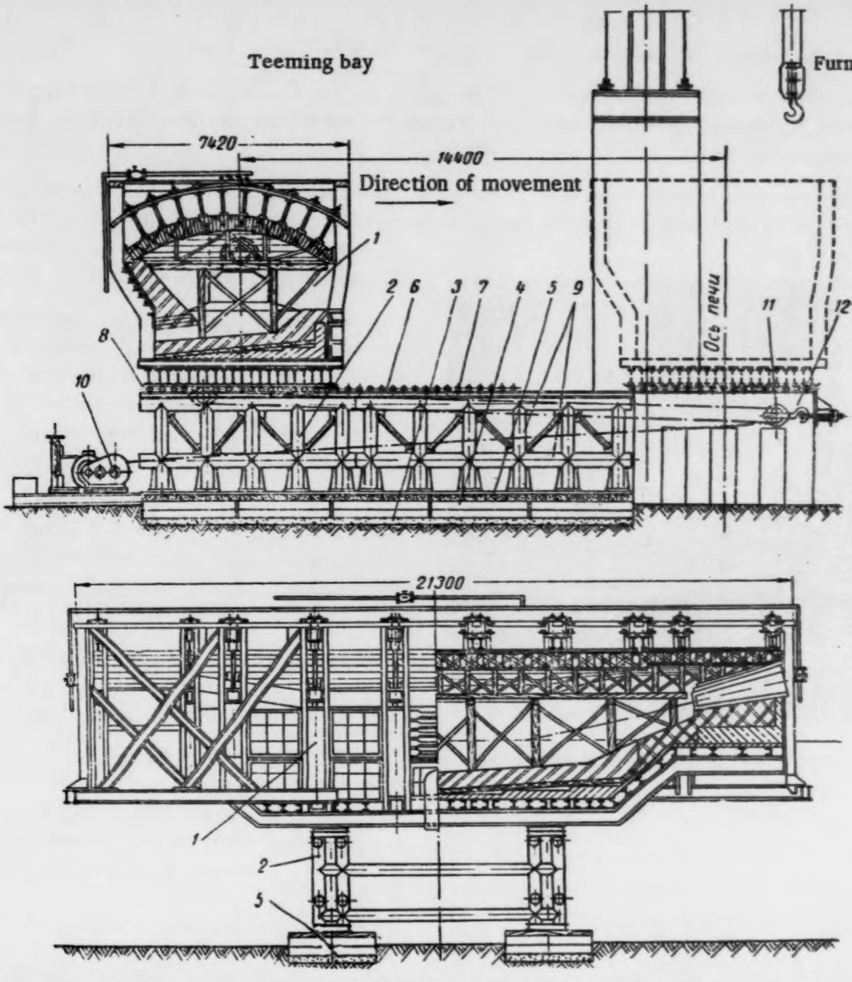

Fig. 1. Organization of the large-unit installation of the metal refractory masonry of the superstructure of the open-hearth furnace. 1) Consolidated block of the superstructure of the furnace; 2) temporary stand for mounting the consolidated block; 3) sand cushion underneath the stand; 4) iron plates (bottom plates); 5) rail piles; 6) steel sheet beneath the rollers; 7) steel rollers 100 mm in diameter; 8) steel sheet with recurved ends; 9) intermediate temporary foundation for mounting; 10) 5-ton electric winch for mounting the consolidated block; 11) 8-thread pulley blocks; 12) main foundation of the furnace.

The consolidated block is moved on rollers (Fig. 2) by two 5-10-ton winches and two 8-thread pulley blocks. The mounting process takes 1-1.5 hr.

After mounting, alignment, and final installation of the block in the intended place on the foundation, metal wedges are driven between the rollers.

If the width of the teeming bay is insufficient and precludes assembly of the consolidated block of superstructure next to the furnace during its operation, the metal structure is assembled to one side of the furnace in a free space of the open-hearth plant. After the furnace is stopped, the temporary stand is set up right against the main foundation, and the assembled block of the metal structure is moved onto it with overhead cranes. The refractory masonry of the furnace superstructure is laid in on the stand during the disassembly and construction work. The block with the masonry is mounted after the disassembly work is completed and an appreciable part of the construction and restoration work at the base of the furnace is finished.

The large-unit installation of the metal and refractory masonry of the superstructure of the open-hearth furnace has the following advantages:

a) The time required for major overhauls of an open-hearth furnace is shortened by 2.5-3 days;

b) completion of a major part of the construction and refractory masonry work during the less busy, preparatory period before the furnace is stopped appreciably reduces the demand on manpower during the busy repair period while the furnace is shut down;

c) the separate performance of the work on the consolidated assembly of the metal structure and refractory masonry of the furnace superstructure in a free part of the plant before stopping the furnace for repair promotes an increase in labor productivity and an improvement in the quality and safety of the work;

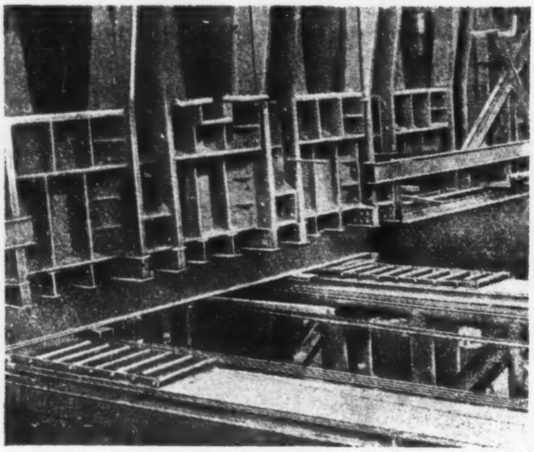

Fig. 2. Moving the consolidated block of the superstructure of an open-hearth furnace with its refractory masonry on rollers.

d) the mounting apparatus (assembly stand and temporary foundation) is used as stock equipment for a number of repairs, which makes this method economically feasible; expenditures for construction of the stand and the temporary foundation amount to approximately 2.0-2.5 thousand rubles;

e) the use of this method makes it possible to obtain an additional 2000 tons of steel and a saving of 6000 rubles for each major overhaoul of a 200-300 ton open-hearth furnace by curtailing the length of the overhaul.

During 1959-1960 in the metallurgical plants of the Urals, eight major overhauls of open-hearth furnaces have been conducted by the method described.

The simplicity of the solution to construction problems and of the technology of mounting and also the economical advantages offer a possibly wide application of this method during major overhauls of open-hearth furnaces at metallurgical plants in other parts of the country.

BLIND-BOTTOM MOLDS WITH WALLS OF UNIFORM THICKNESS

L. A. Bol'shakov and E. K. Turchenkova

Zhdanov Metallurgical Institute and the plant "Azovstal'"
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The wall thickness of molds for killed steel usually increases evenly downward by 20-25% for improved durability and also for more effective cooling of the cast steel.

Observations have shown that the lower part of heavy blind-bottom molds does not function properly during solidification of the ingot: the upper part becomes red hot, but the lower (the massive part) remains dark. The uneven heating of the mold promotes the development of additional stresses, which upon repeated heating and cooling lead to premature formation of cracks and a corrosion network on the inner surface.

TABLE 1. Characteristics of the Rail Molds

Mold	Weight of ingot, tons	Weight of mold, tons	Weight of mold to weight of ingot ratio	Thickness of walls, mm		Cross section, mm		Inner height, mm
				top	bottom	top	bottom	
Ordinary R-8 (before change) . .	9.76	12.0	1.23	160	202	865×770	735×640	2210
Even-walled R-10 (after change)	9.76	10.0	1.02	160	160	865×770	735×640	2210
Ordinary R-7 (before change) . .	8.30	10.1	1.22	140	186	825×720	681×576	2140
Even-walled R-9 (after change)	8.30	8.5	1.02	140	140	825×720	681×576	2140

At the plant "Azovstal'" molds with walls of uniform thickness have been used for casting rail ingots weighing 8.30 and 9.76 tons (Table 1).

The even-walled and ordinary molds were used under identical service conditions in the open-hearth plant; they were distributed on the carts three in a row spaced 150-250 mm; the ingots remained in the molds 4-4.5 hr.

TABLE 2. Durability of Even-Walled and Ordinary Molds

Mold	Mold consumption, kg/ton of steel	Durability (number of castings)	Failure, %, as a result of			
			crack formation	corrosion of walls	corrosion of bottom part	other reasons
Ordinary R-8	30.5	40.3	14.89	48.58	34.69	1.84
Even-walled R-10	23.2	44.1	18.19	56.10	24.00	1.91
Ordinary R-7	34.3	35.5	39.64	47.60	11.55	1.21
Even-walled R-9	21.0	48.8	10.00	45.00	45.00	—

The chemical composition of the iron of the molds in percent is

C	Si	Mn	P	S
3.35—3.70	1.4—2.4	0.50—1.00	0.11—0.20	0.06—0.10

Cr	Ni
To 0.15	To 0.15

In Table 2 are given data on the durability of the molds based on an average number of casts.

As is evident from Table 2, the specific consumption of the even-walled light molds amounted to 21.0-23.2 instead of 30.5-34.3 kg/ton for the heavy molds of the types R-7 and R-8. Their period of service proved to be appreciably higher than that for the ordinary molds. The even-walled molds are distinguished by high resistance to thermal shocks and to the appearance of through-going cracks during the development of the highest stresses and are therefore less subject to emergency discharge if cracks form during the first casts.

They are also better than the ordinary molds in resistance to corrosion of the bottom and walls. The molds of the new design possess increased resistance to the corrosive action of the metal stream in the spherical part of the bottom as a consequence of a more dense and fine-grained structure of the iron, formed as a result of accelerated cooling during casting.

Likewise, reduction of the magnitude of the weight of mold to weight of ingot ratio from 1.22-1.23 to 1.02 by making the walls of uniform thickness does not impair the quality of the ingots; the average service durability of the molds is significantly increased, and the specific consumption under analogous working conditions is decreased from 30.5-34.3 to 21.0-23.2 kg/ton of steel.

Putting even-walled molds into mass production permitted the total specific consumption of molds throughout the plant to be reduced from 20.1 to 16.5 kg/ton of steel during 1960 and effected a saving of about 0.3 million rubles.

CASTING STEEL UNDER A PROTECTIVE LAYER OF MICA

S. P. Bakumenko, A. M. Svistunov, and É. V. Verkhovtsev

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As an insulator, mica has low thermal conductivity and a small volume density. Because of these properties, it is expedient to use this material as a thermal insulating (protective) cover.

The effect of casting under a mica layer on the quality of the ingot has been evaluated with open-hearth steel. The metal was bottom cast into ingots weighing from 0.7 to 3.5 tons in 6-8 partial molds; the molds were filled at a rate of 0.2-0.4 m/min.

Mica was introduced into the molds either before casting or as the metal entered (after the plug of the ladle was opened). In the first instance (Fig. 1a), molds prepared in accordance with current plant technology were completely smeared with a mixture (50%) of resin and coal-tar lacquer; the bottom orifice of the mold was then covered with a sheet of paper and the mica added. In the second instance (Fig. 1b), the mica was introduced after casting began (the preparation of the mold was the same as in the first instance). Mica consumption per ton of steel amounted to 1.0-1.5 kg.

The surface quality of the ingots poured under the protective mica layer was determined by inspection of each ingot; all surface defects were hereby recorded. For comparison, part of the ingots were simultaneously cast without mica.

Layers of scale, scabs, fireclay contamination, and so on are absent from the ingots cast under the protective mica layer. Mica deposits are found on the surface of ingots poured with the addition of mica after the casting began, especially on the hemisphere (the lower curvature of the ingot). The degree and character of contamination of the surface of the ingots depends on the quality of the coating of the mold, the rate of filling the bottom of the mold, and the chemical composition of the steel. In Fig. 1c is shown an ingot poured under a mica cover, but without smearing the mold. The major part of its surface is covered with a light deposit of mica, since, during movement of metal in the mold, part of the mica catches in rough places of the mold walls, is separated from the mass of the mica, and because the mica plates lack cohesive strength in unsmeared places, they cover the surface of the ingot as a light deposit.

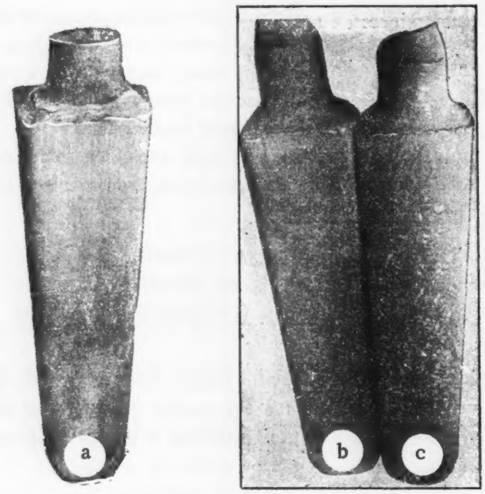

Fig. 1. Steel ingots 65G weighing 3.5 tons, cast with mica added: a) before casting began; b) after casting began; c) without smearing the mold.

Statistical data from the inspection of the surface of 1071 ingots, cast by the ordinary procedure and with the use of mica, are given in Table 3. The surface quality of ingots of carbon and alloy steels sharply distinguishes them from ordinary ingots. Such coarse defects as scale layers, scabs, and contamination with various inclusions are almost entirely absent from the experimental ingots. The number of experimental, carbon-steel ingots submitted to cleaning is 16 times less than for ordinary ingots, and the number of experimental, alloy-steel ingots—4.8 times less.

The surface quality of ingots from 18-30KhGT steel, cast with the addition of mica to the mold before pouring, is worse than that of the carbon and alloy steels; this is explained by the rapid filling of the bottom of the mold. Consequently, it is expedient to add the mica after the filling of the bottom of the mold when working with fast-pour types of steel.

Surface Defects of Ingots Cast with the Addition of Mica to the Molds as Compared with Ordinary Ingots (bottom casting)

Steel	Casting procedure	No. of ingots	Surface defects, %: light deposits of mica: on the hemisphere	light deposits of mica: on $^2/_3$ of the length	light deposits of mica: on the entire length	Coarse deposits of mica on the hemisphere (bottom of the ingot)	cracks on the hemisphere under the deposit	scoria of fused mica	scale layers	scoria	scabs, holes	dirt, fireclay	Number of ingots autogenously cleaned in the foundry, %
Carbon 10-60	Mica on mold bottom	251	50.5	4.79	12.3	–	–	3.2	0.4	–	–	–	3.85
	Without mica	164							36	1.22	6.7	31.1	63
Alloy (chrome-nickel, chrome, manganese, chrome-silicon, chrome-manganes-silicon)*	Mica on mold bottom	178	59.5	16.7	12.1	1.15	–	7.5	1.15	–	–	–	10
	Without mica	130	–	–	–	–	–	–	18.5	4.6	15.4	33.1	48.5
18-30KhGT*	Mica added on metal after opening ladle plug	25	–	6.2	–	–	–	–	–	–	–	–	–
18-30KhGT*	Mica on mold bottom	40	100	17.5	17.5	43	23.3	35	5	–	–	–	–
	Without mica	71	–	–	–	–	–	–	24	11.3	2.82	29.6	–
Carbon and chrome**	Mica on mold bottom	71	42.3	–	–	–	–	–	–	–	–	–	
	Without mica	166	–	–	–	–	–	–	–	–	–	–	–

*Weight of ingot 3.0-3.5 tons.

**Weight of ingot 0.7 tons.

It is evident that casting steel under a protective mica layer improves the surface of the ingots and sharply reduces the number of ingots which must be cleaned.

Examination of the macrostructure of sectioned templets, selected during rolling from upper and lower parts of the ingot, has shown that scale layers and subscale defects are almost entirely absent from the upper part of ingots. Improvement in quality is also noted in the lower part of ingots.

The ingots cast with mica were also inspected for contamination with nonmetallic inclusions by means of polished sections taken from the periphery, hemisphere, and center of the templet.

Testing has shown that there is no possibility of contamination of the steel with nonmetallic inclusions by casting under a mica layer; contamination of steel from the experimental casts is no higher than from ordinary casts.

One includes that the use of mica in the mold provides steel ingots without scale and with a higher quality surface and macrostructure.

Under conditions of thermal insulation of the metal in the mold, the use of mica makes it possible to pour the steel at a reduced rate without scale formation; this is of great importance for low-carbon steels which tend to form cracks when poured rapidly.

EXTENDING THE LIFE OF SLAG POTS

V. A. Ivanov

Kuznetsk Metallurgical Combine

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p. 18, September 1961

Slag pots in the electric steel foundry went out of order chiefly because of horizontal and vertical cracks which formed as a consequence of sharp temperature fluctuations in the walls under the influence of molten slag.

A group of innovators proposed mounting a stiffening rib on the exterior surfaces of the sides of the pot, and specially designed steel bars (cleats or reinforcing iron) on the interior surfaces. If cracks form in the walls of the slag pots toward the end of their service period, the cleats prevent them from widening; the slag pot may still be used, since the slag does not leak through the cracks.

Percent of chemical composition of the iron for the slag pots is

C	Si	Mn	P	S
3.4—3.6	1.8—2.1	0.8	0.25	0.12

The pot is kept in the mold 50-60 hr after casting; it weighs 5.7 tons.

Mounting the stiffening ribs and the specially designed steel reinforcing bars and also improving the cooling regime in the mold have permitted the life of the slag pots to be increased about twofold and have allowed a saving of about 1200 rubles.

PACKED MATERIALS FOR LINING THE GATES OF THE CHARGING WINDOWS OF THE OPEN-HEARTH FURNACE

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NTMC and the Eastern Institute of Refractories

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Employees of the NTMC and the Eastern Institute of Refractories conducted research on the selection of the most effective, packed, refractory masses from magnesite-chromite, magnesite, and periclase-spinel materials. The selected compositions may be used for lining the gates of the charging windows and the steel notches of open-hearth furnaces, and also for preparing various refractory units.

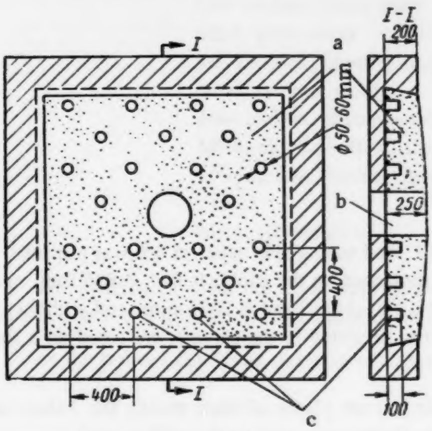

Fig. 1. Diagram of a charging window with the packed lining. a) Packed material; b) metal pipe; c) metal tubes.

Reinforced packed gates (Fig. 2) for the charging windows were prepared in the combine from waste of the three materials; the granular composition of the powders, the composition of the mixtures, the moisture content of the materials, and the density of the additives used for lining the gates are given in Table 4.

The components of the mixture were mixed in a paddle agitator (7-8 min) with the addition of a sulfite-alcohol residue and dregs from the pickling bath of the rolling mill to a moisture content of 5-7%.

The lining was packed in layers of 15-20 mm; the total thickness was 200-250 mm. Metal tubes 100-120 mm high and 50-60 mm in diameter were welded onto the packed surface in a staggered pattern.

From 10-12 pipes were used per 1 m^2 of gate surface; these can be replaced with iron plates 2-3 mm thick to form a rectangle 200 × 300 mm. The gates with the lining packed in were dried at a temperature of 20-30° for 48 hr.

Granular Composition of Powders, Composition of the Mixtures, Density of Additives, and Moisture Content of the Materials Used for Packing Gates of the Charging Windows

Material	Granular comp. of powders, %						Composition of the mixture, %								Moisture content of materials, %	Density of additives g. cm³		
	3 mm	3–1.5 mm	1.5–1.0 mm	1.0–0.5 mm	0.5–0.2 mm	0.2 mm	peric-spinel (2-0 mm)	mag.-chromite (2-0 mm)	magnesite (2-0 mm)	magnesite (0.088 mm)	ilmenite	sulfite-alcohol residue (solution)	$MgSO_4$	dregs from pickling bath		sulfite-alcohol residue	$MgSO_4$	pickling dregs
Periclase-spinel	7.5	21.8	21.7	11.1	15.2	22.7	75	—	—	25	2	3.0	3.5	3.5	6—7	1.22—1.28	1.20—1.22	1.22—1.26
Magnesite-chromite	8.6	23.7	31.3	13.2	3.1	18.1	—	75	—	25	2	3.0	3.5	3.5	5—6	1.22—1.28	1.20—1.22	1.22—1.26
Magnesite	11.3	18.2	17 1	12.7	14.9	25.2	—	—	75	25	2	3.0	3.5	3.5	5—6	1.22—1.28	1.20—1.22	1.22—1.26

Note: A solution of $MgSO_4$ or dregs from the pickling bath were used to moisten the materials.

The gates were tested in a 370-ton open-hearth furnace with basic arches, operating with the use of oxygen. Their durability with the periclase-spinel material reached 26 days, with magnesite-chromite– 19 days, and with magnesite– 17 days. The durability of ordinary gates lined with fireclay brick averages 6-7 days.

The tests showed that the reinforced, packed lining of waste periclase-spinel products has a durability 3-4 times higher than the fireclay lining.

Observations of the service of the packed lining have revealed that deterioration of the lining occurs as a result of spalling,which is in part occasioned by the mechanical jars of the gates, against the furnace.

THE REDUCTION OF TRANSVERSE CRACKS IN STRUCTURAL STEEL INGOTS

V. A. Nosov and N. N. Vlasov

Serov Metallurgical Combine
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An ingot weighing 5 tons, of elongated form, with $N/D_{sr} = 3.51$, and with a side taper of 4%,was put into production in the combine. The upper cross section of the ingot (as measured on the mold) is 640 × 640 mm, and the lower cross section is 500 × 500 mm; total height of the ingot with shrinkage head is 2375 mm, and without shrinkage head– 2000 mm. The molds, which are chamfered (for better breaking of the sprues), are stood on a four-place bottom plate.

The steel was bottom cast with the use of wooden casings on the bottom plates of three molds; the behaviour of the metal was observed in the fourth mold. After stripping, the hot ingots were sent to the rolling mill.

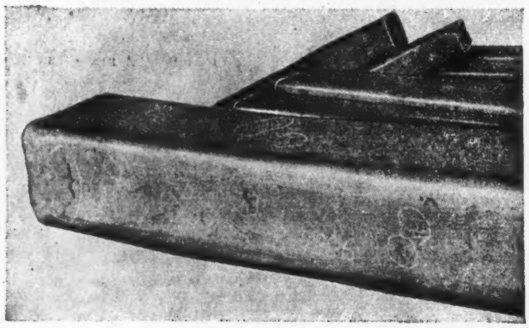

Fig. 1. Transverse cracks on an unrollable 5-ton ingot.

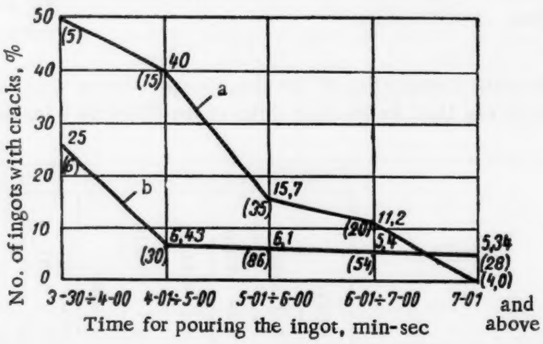

Fig. 2. Effect of the time required to pour the ingot on the number of ingots with transverse cracks (numbers in parentheses indicate the number of castings). a) Curve for ingots of low-carbon steel; b) curve for ingots of mild steel.

At the time that the new type ingots were being put into production, a large number of the ingots were observed to have transverse cracks which were not ordinarily apparent during stripping, but were discovered when the ingots were rolled on the 850 mill after several passes at a comparatively wide setting (Fig. 1). Along the height of the ingot, about 50-55% of the cracks were found in the lower part, 30% in the middle, and 15-20% in the upper part. Upon further rolling, the cracks develop into scabs which in many cases require that the metal be counted as waste.

In order to discover the reasons for the formation of the cracks, the effects of the rate of pouring and the chamfer of the molds on the ingots were tested. For 20 heats half of the metal was poured into unchamfered molds, and the rest—into chamfered. The results of the casting have shown that the chamfer of the molds has no effect on the number of ingots with cracks.

In order to determine the influence of the rate and temperature of pouring the steel on the quality of the ingot, 126 experimental heats were conducted in which the temperature of the metal was reduced before tapping, and the time of pouring the ingot was increased. This technology reduced the number of ingots with cracks to 4.7% for low-carbon steel and to 3.84% for mild steel (Fig. 2).

On the basis of the data obtained, the following corrected specifications of the temperature limits of the metal before tapping (°C) and the time of pouring the ingot were introduced into the technological instructions:

	Temperature limits	
	old	corrected
Low-carbon, plain steel	1605-1630	1600-1625
Mild, plain steel	1565-1625	1595-1615
Low-carbon, chrome steel	1605-1635	1605-1630
Mild, chrome steel	1600-1630	1600-1625
Low-carbon, chrome-nickel steel	1610-1640	1610-1635
Mild, chrome-nickel steel	1600-1625	1600-1620
Low-carbon, chrome-molybdenum steel	1605-1635	1605-1630
Mild, silicon steel	1590-1620	1590-1615

The pouring time for the ingot was fixed within the limits of 5.5-7 min when casting metal at normal temperature and 7-8.5 min when casting hotter metal.

At the present time, the quantity of 5.0-ton ingots with transverse cracks amounts to 3.0-4.0%.

AUTOMATING THE TEEMING OF STEEL

V. D. Smolyarenko

Gripromez

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pp. 20-22, September, 1961

The automation and mechanization of laborious processes is being carried out in all branches of industry, including the teeming of metal. Work on the mechanization of teeming has resulted in remote control of the ladle stoppers.

At the Kuznetsk Metallurgical Combine there is an electro-hydraulic system of remote stopper control in a 200-ton double-stopper ladle (Fig. 1). This system gives smooth opening of both stoppers with the technologically optimum rate, independent operation of each of two stoppers synchronously or separately, and if necessary rapid changeover to manual control. Heavy physical labor is completely eliminated and the work is safer.

A correctly chosen rate of pouring makes it possible to reduce the number of flaws in the bottom part of the ingot, giving an average of 1.5% increase in the yield of useful metal, for example when teeming rimming metal.

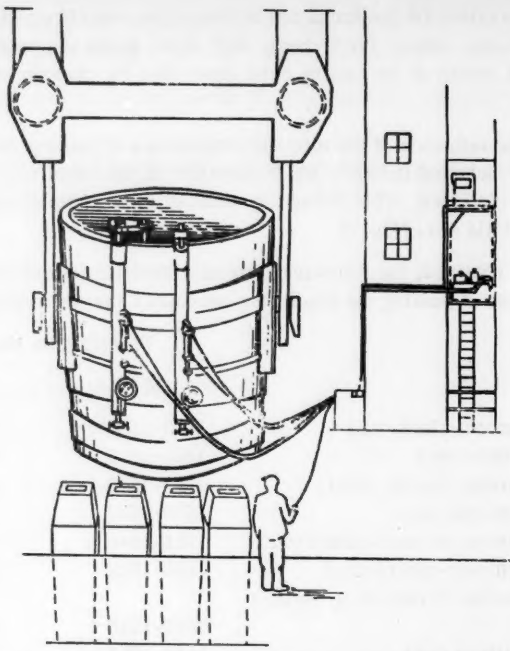

Fig. 1. Remote control of double-stopper system of a steel-teeming ladle.

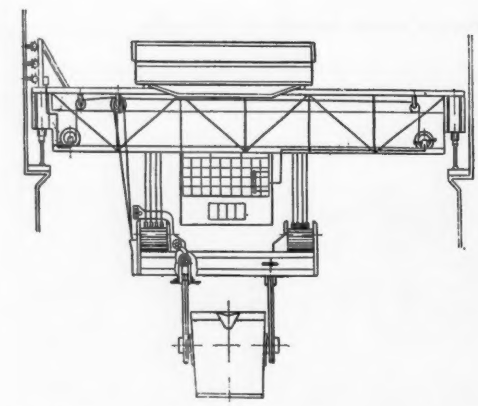

Fig. 2. 160-ton ladle crane with electronic scale built into the cross member.

A new step in the automation of teeming and in the whole process of steel production was made after the introduction into industry of reliable electronic crane scales. The first industrial tests of crane scales were carried out at the Dortmund Herder Hüttenunion Plant in Dortmund (West Germany) on a 160-ton ladle crane.

The scale is a tensometric (pressure) dynamometer built into the cross member of the ladle crane. From the dynamometer an electric pulse (voltage) is transmitted to an amplifying block and to indicating instruments. The circuit of the scale is arranged so that the weight of the tare is compensated before the ladle is filled so that the scale indicates only the weight of molten steel.

To transmit the readings of the crane scales during the teeming to the personnel on the teeming platform, the crane has a board which shows in large illuminated figures the changing weight of the steel in the ladle (a change in weight of not less than 0.1% of the maximum). The board can easily be seen from any point of the building.

Figure 3 shows the arrangement of a 160-ton ladle crane with built-in electronic scales. The change in weight of the molten steel during the teeming is recorded by a recording instrument on a special paper with time-weight coordinates. From the recorded curve it is possible to determine at any time the time of soaking of the metal in the ladle, the rate of teeming, etc. This record is an objective document when analyzing reasons for rejects during teeming.

The change in the crane scales, for example during bottom pouring, gives better distribution of the metal in the stools and molds so that the least amount of metal pours into the reserve molds. In this case the yield of useful metal was increased by 2.4% and the costs of the electronic crane scales were recovered in six months operation.

Arrangement of Weighing Elements on the Crane

Position	System	Advantages	Faults
Fig. 3, I	Measuring element at point of weighing hook.	Simplicity of design, no losses in the height of ascent, applicable everywhere, continuous weighing possible.	Poor Protection from high temperatures. The ladle cranes have to be air-cooled. The dynamometer is loaded during any operation of the crane, movement of the crane is difficult.
Fig. 3, II	Double cross piece with measuring elements.	Simplicity of design, continuous weighing is possible, better protection from high temperatures than in position I. Easy movement of hook.	Losses in height of ascent. The dynamometers are loaded during any operation of the crane.
Fig. 3, III	Weighing with crane trolley.	Good protection from high temperatures. Dynamometers are loaded only during weighing.	Weighing is not possible during movement of the trolley. Movement of the crane is limited.
Fig. 3, IV	Weighing with hoist mechanism.	As in position III. Continuous weighing is possible regardless of the movement of the trolley.	Can only be installed at newly constructed cranes, considerable modifications are needed on operating cranes.

Various ways of arranging the scale elements on the crane are shown below (Fig. 3). The advantages and faults of each arrangement are shown in the table.

Combining the mechanism of remote stopper control and the crane scales for weighing the poured metal into one system led to a device for the automatic teeming of steel as ingots with a given weight.

In the ideal case each ingot should give a certain number of blooms, sheet bars, slabs of required weight or size. However, at the present time this is not the case. The deviation from a given weight most cases is due to three factors:

1) The operator cannot see when the level of the metal agrees with the line previously marked on the inside surface of the mold, due to smoke, flame and intensive liberation of heat;

2) the different degree of shrinkage of the metal due to gas evolution and cooling;

3) change in the dimensions of the mold with wear.

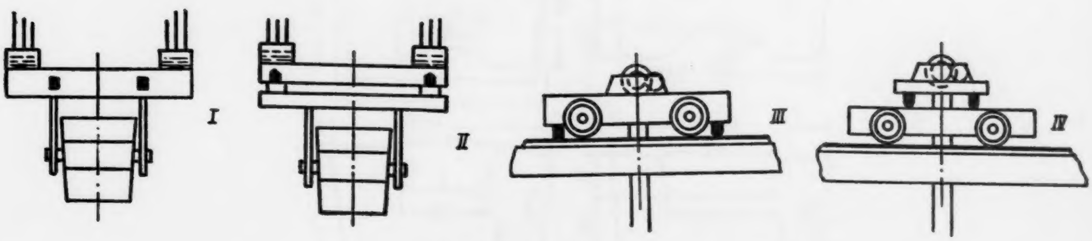

Fig. 3. Arrangements of weighing elements on the crane.

A device known as the "ingotrol" is used at the Youngstown Plant. An essential condition of operation for this device is that it should be compatible with the existing equipment of the department and technological process used in it.

The problem facing the designers was to cast an ingot weighing 5 tons differing in weight by not more than 1%, i.e., a total load of 400 tons had to be separated into parts, weighed and poured with an accuracy of 40-50 kg.

The weighing mechanism therefore had to weigh the metal with an accuracy of 1/80%, and this measurement had to be made within a few tens of centimeters from the surface of the molten steel which had a temperature of 1540°

The special steel-teeming ladle cross member in which there were eight dynamometers, each at a load of 40-50 tons for a ladle with metal weighing 360-400 tons was made by the Republics Massillon firm. An electromagnetic system connecting the stopper with the electronic scales was planned to control the hydraulic device for moving the stoppers.

Having collected a given weight of metal the scales give a pulse to the control mechanism and the stopper closes.

The "ingotrol" device operates in the following order: the crane operator switches on the electronic scales and lowers the ladle to the teeming platform from which hydraulic cylinders are adjusted on the ladle. The operator begins teeming and controls the movement of the stopper with a portable control.

As the mold is filled the weighing device gives the operator an audible warning and he changes the rate of teeming in the top part. On reaching the indicated weight the stopper automatically closes, preventing the entry of steel into the mold.

During automatic teeming 69% of the cast ingots had deviations from the given weight of ±1% with a maximum deviation of ±3% (ingots cast with the usual method had deviations of ±8%).

A NEW ECONOMICAL PROFILE, GK-06

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Zlatoustovsk Metallurgical Factory and the Siberia Metallurgical Institute

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At the Zlatoustovsk Metallurgical Factory, a new economic profile GK-06 (Fig. 1) of alloy steel ÉI 415 or 30KhGSA has been brought into production.

The profile is rolled on the medium section mill 400 No. 2, consisting of four three-high mills set out in one train. The billets (85 mm square) are preheated in a continuous furnace and rolled to the finished profile in eight passes: the first four in No. I stand, three in No. II and the final finishing pass in No. III stand.

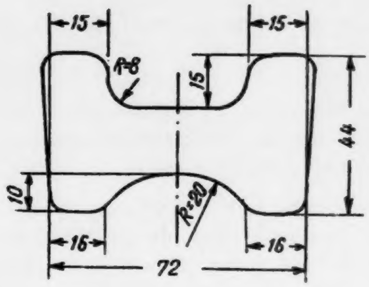

Fig. 1. Profile GK-06.

Profile GK-06 is shaped in four section grooves from the rolled billet 63 mm square (Fig. 2). The first of these (5) is made semienclosed with wide indenting ridges, and this makes it possible to reduce the diameter of the ridges of the enclosed pass, and weakens the roll less in the region in which the open pass of the groove is situated. The broad and flat cutting ridges ensure good stability of the workpiece in the groove. Grooves 6-8 are enclosed girder-type with steady positioning of the joint. In order to avoid extrustion of the metal into the clearance and the formation of fins, the internal angles of the upper flanges of grooves 5 and 6 are tapered. All the section grooves are designed to work with limited lateral broadening, and this contributes to the more accurate forming of the parts of the profile.

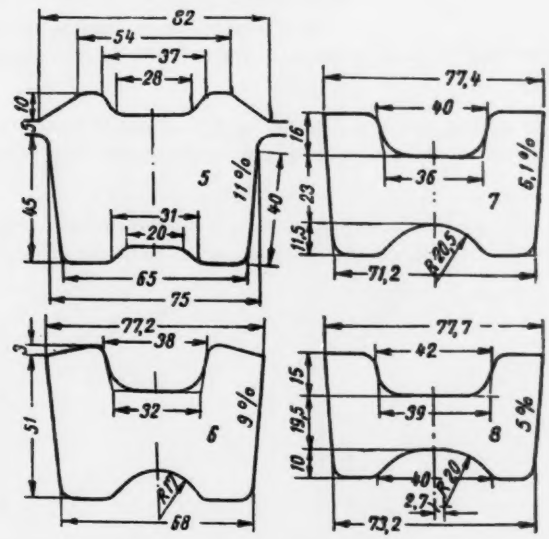

Fig. 2. Groove design for profile (GK-06) (passes No. 5 to 8).

Analysis of Groove-Design

Pass	Groove	Work-piece dimensions, mm				Cross-sectional area, mm^2			Reduction coefficient			Reduction, mm			Widening, mm	Angle of grip, deg-min
		H	h	B	A	web	flange	total	web	flange	average	web	flange	total		
	Billet	111	—	111	85	—	—	7100	—	—	—	—	—	—	—	—
1	Square	97	—	113	82	—	—	6570	—	—	1.08	—	—	14	2	17—12
2	"	89.5	—	101	73	—	—	5360	—	—	1.23	—	—	23.5	4	22—10
3	Rhombus	76	—	93	—	—	—	4290	—	—	1.25	—	—	25	3.5	22—45
4	Square	80.5	—	80	63	—	—	3880	—	—	1.11	—	—	12.5	4	16—15
5	Section	60	46	68	—	1330	2170	3500	—	—	1.11	17	3	—	5	17—50
6		54	28	71	—	1000	1800	2800	1.33	1.21	1.25	18	6	—	3	17—50
7	"	50.5	23	74	—	960	1760	2720	1.04	1.02	1.03	5	3,5	—	3	9—20
8	"	44.5	19.5	77	—	900	1580	2480	1.07	1.11	1.09	3.5	6	—	3	10—30

Note: For squares and rhombus: H and B are the vertical and horizontal diagonals. For the section profiles: H and h are the height of flanges and web respectively; B is the width.

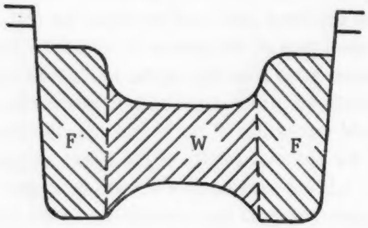

Fig. 3. Diagram showing how profile GK-06 is divided. F–flanges; W–web.

Figures which characterize the rolling of profile GK-06 are set out in the table. In calculating the coefficients, the division of the profile into the parts shown in Fig. 3 was used.

In arranging the grooves in the rolls the following considerations were used as a guide. Because of the limitation of widening of the workpiece in the enclosed groove, the workpiece jams and tries to snake around the rolls. Therefore the enclosed groove was positioned in the lower roll (for a given pass). In order not to excessively increase the diameter of the ridges on the lower roll and not to weaken the upper, the dimensions of the rolling diameters were taken to be almost exactly identical (the difference exceeded 4 mm); because of this the workpiece continuously attempts to curve downwards. To prevent snaking of the workpiece around the lower roll, forged steel guides are used, installed at the enclosed grooves.

The rolling of experimental, and then of production batches of profile GK-06 has shown that with correct setting-up of the mill, the metal fills all the grooves well, and the finished profile has the necessary dimensions and a good quality surface.

The use of profile GK-06 in machine construction instead of a flat rolled product makes it possible to save about 30% of expensive alloyed metal, and considerably reduces the difficulty of mechanical working in the preparation of machine components.

EXPERIMENTAL ROLLING OF THICK PLATES FROM CONVERTER STEEL

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Translated from Metallurg, No. 9, pp. 24-25, September, 1961

Experimental rolling of four melts of killed and rimming converter steel K St. 3 to plates 12, 20 and 30 mm thick has been carried out in a plate mill. For a comparison of the mechanical properties, metal from two open-hearth melts of killed and rimming steel M St. 3 was rolled at the same time into plates of the same thicknesses.

Before cutting, each plate was inspected from both sides for evidence of external defects, and after cutting, on the exposed edges for evidence of laminations.

Converter and open-hearth rimming steel was poured into open slab ingot-molds type L-VI, dimensions $\frac{1008 \times 285}{1040 \times 340} \times 1650$ mm, to give ingots weighing 3 tons. Killed converter and open-hearth steel was poured into ingots weighing 3.17 tons in solid-bottom ingot-molds having dimensions $\frac{950 \times 340}{910 \times 300} \times 1410$ mm with hot tops.

Each experimental melt consisted of four ingots which were rolled to plates $12 \times 2300 \times 7200$-9000 mm, 20×1500-1800×6400-7500-8000 mm and 30×1500-1800×4200-5400 mm.

The 20 mm thick plates were investigated for segregation, and tensile tests were carried out together with impact tests at + 20 and −20°C.

All the experimental metal was preheated in the furnaces of the plate-rolling shop according to same schedule. The temperature at the start and finish of rolling, the number of passes and the consumption of gas and air in each preheating furnace were controlled. Maximum reductions were used in the first passes: toward the end of rolling, the reductions were decreased.

After rolling and straightening, the plates were cooled in stacks, and after the temperature had fallen to about 100°C they were cut to measured lengths.

Transverse test-pieces were cut from the plate for tensile and notched impact testing.

The trials have shown that the mechanical properties of converter metal—both killed and rimming—are not inferior to the mechanical properties of open-hearth plate metal. In the examination and sectioning of plates of converter metal, no external or internal defects in the form of seams, scales or cracks were observed.

The behavior of this metal in rolling was fully satisfactory: the ingots deform easily enough in the same percentage reductions as used for open-hearth plate metal.

Just as for open-hearth steel, so for converter metal, chemical composition plays the chief role in obtaining high properties. Carbon, manganese and phosphorus contents at the upper specification limit increase the strength characteristics of the metal and lower the percentage elongation.

CONTACT SEALS FOR SEALING ROTATING SHAFTS

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The results of the investigations of a number of metallurgical factories in the Dnepropetrovsk sovnarkhoz indicate that, on existing equipment, because of the imperfect design of the sealing units for rotating shafts, losses of lubricating materials (industrial and cylinder oil, motor oil, P-28 lubricant etc.) are large.

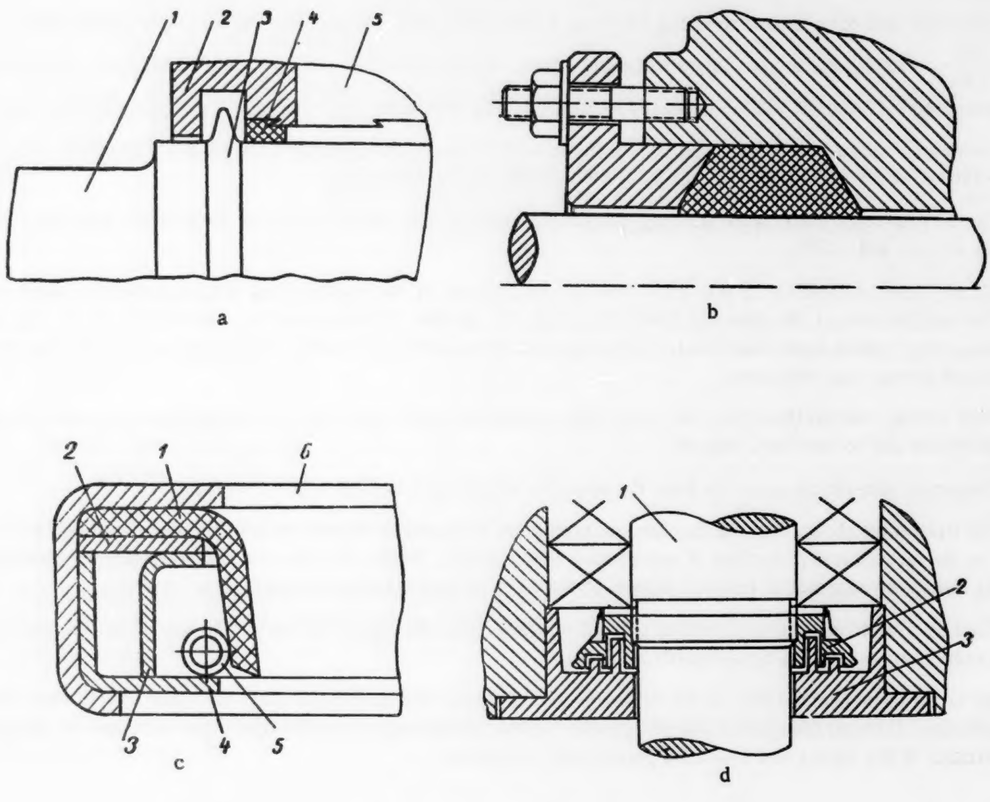

Fig. 1. Sealing units. a) With repelling collar; 1) shaft, 2) bush, 3) repelling collar, 4) babbit casting, 5) lubricating bath. b) Seal with soft packing. c) Cup seal; 1) cup, 2) washer, 3) collar, 4) cover, 5) spring, 6) body. d) Labyrinth seal; 1) shaft, 2) and 3) rotating and fixed labyrinth collars.

The most widespread types of sealing on outgoing rotating shafts are seals in the form of repelling collars, stuffing boxes, cup packing and labyrinth seals.

On the shafts of pinion stands seals are usually installed in the form of repelling collars (Fig. 1,a). The inadequacy of such sealing is its very low leak-tightness. The exit shafts of lifting tilting tables with such seals use

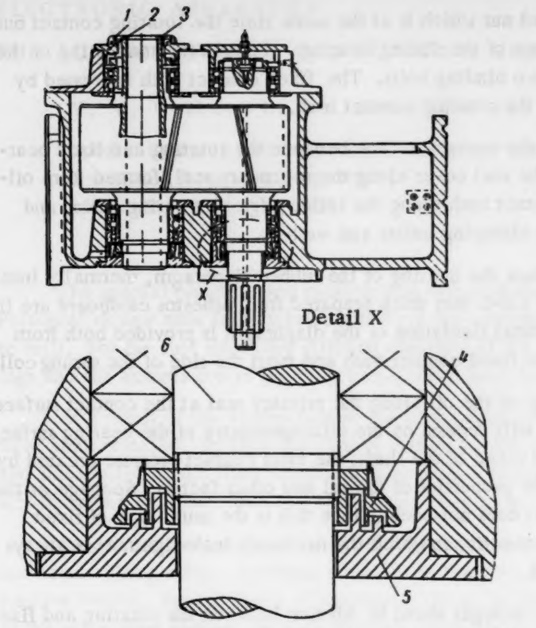

Fig. 2. Vertical reduction gear of wire mill. 1) Gasket, 2) cover, 3) seal, 4) and 5) rotating and fixed labyrinth collars, 6) shaft.

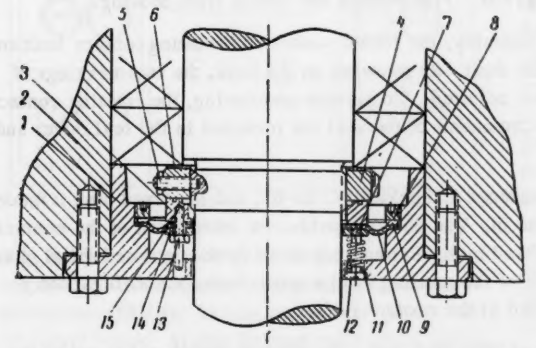

Fig. 3. External open-sided contact seal. 1) Seal cover; 2) body of the reduction gear; 3) and 4) fixed and moving contact bushes; 5) binding bolts; 6) folded washer; 7) positioning pin; 8) clamping collar; 9) washer; 10) diaphragm; 11) springs; 12) plug screws 13) locators; 14) sprung collar; 15) thermally insulating gaskets.

up to 60 kg of oil per week, and the pinion stands require 100-280 kg of oil per day.

Stuffing boxes (Fig. 1 b) although they are both simple in design and maintenance, require a large consumption of soft packing and the shaft is rapidly worn away in the zone in which the seal works. Dependable working of the seal is possible only if the liquid seeps through the seal; in this way lubrication of the bearing surfaces is ensured.

Cup seals are widely used (Fig. 1 c). They are highly leak-proof and are installed on shafts having a peripheral speed of up to 8 m/sec. The service life of such cups is 6-8 months. In renewing them the working surface of the shaft has to be reground; if this is not done, the leak-tightness of the seal is reduced. The outgoing shafts of electric flying shears with cup seals require up to 2 tons of oil per day. More frequently such seals are used for making the face parts of sliding bearing leak-proof.

Labyrinth seals (Fig. 1 d) allow practically any peripheral speed, retain oil during rotation of the shaft with adequate dependability and have low leak-tightness at rest.

All the seals set out above, because of the presence of a clearance between the rotating shaft and the sealing edges of the sealing materials allow considerable losses of oil, shaft wear at the places where the seals are installed and high losses of energy in friction.

The department for chemical factory plant in the Dnepropetrovsk Technical Institute, in conjunction with the sovnarkhoz, carried out investigations and constructional development of new types of seals for rotating shafts, the so-called contact seals. The design provides for the creation of the barrier, when the seal unit is working, not on the cylindrical surface of the shaft, as is adopted on existing seal designs, but on the bearing contact surfaces of rotating and fixed contact bushes.

Contact seals, as experience of their use in factory conditions has shown, work well with the lubricating oil at high pressures and temperatures, and also with the outgoing shafts at high peripheral speeds. However, their wide application is hindered by the almost entire absence of scientific and research work to clarify the basic parameters in using the seals in working conditions.

At the Krivorozhsk metallurgical factory, there are 32 vertical reduction gears (Fig. 2) for the stands of a wire mill with vertical rolls. Oil is fed into the reduction gear by a pump under a pressure of 1-2.5 atm and through a sprayer the oil thrown onto the pinions. The oil level in the body of the reduction gear reaches 180-250 mm. Surplus oil is run off into a collecting tank. The leak-tightness of the outgoing reduction gear shafts is achieved by means of a labyrinth seal. Total losses of oil through the seals are 2.4 tons/day. Taking into account the exceptional importance of the detail X (Fig. 2) the authors developed a design of external open-sided contact

seal (Fig. 3), consisting of the reduction gear shaft, a shaped nut which is at the same time the rotating contact bush of the seal, and a tightening nut, tightening the internal rings of the sliding bearings. To prevent unscrewing of the rotating contact bush, it is locked by a folded washer and two binding bolts. The fixed contact bush is pressed by positioning pins and springs with the requisite force against the rotating contact bush.

During rotation of the shaft, oil escapes either along the contact surface between the rotating and fixed bearing (primary seal), or between the fixed contact bush and the seal cover along the secondary seal, formed from oil-resistant rubber. The diaphragm is gripped to the fixed contact bush along the inside edge by a spring collar and locators. The diaphragm is clamped in the seal cover by a clamping collar and washer.

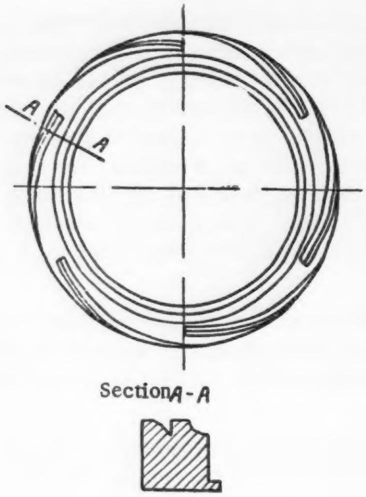

Fig. 4. Spiral channels in bush.

To reduce the heating of the rubber diaphragm, thermally insulating gaskets 1.5-2 mm thick prepared from asbestos cardboard are installed. Thermal insulation of the diaphragm is provided both from the side of the fixed contact bush and from the side of the sprung collar.

Seepage of the oil along the primary seal at the contact surfaces of the bushes will depend on the microgeometry of the bearing surface, the rotational speed of the shaft, the total contact pressure created by the springs, the properties of the oil and other factors. Seepage at the secondary seal does not occur, since this is the usual type of fixed membrane connection in which the necessary leak-tightness is always easily created.

Torque, brought about by friction between the rotating and fixed contact bushes, is not transferred to the diaphragm, but is taken up in the locators. The necessary clamping of the contact bushes is supplied by six springs, the forces of which are regulated by plug screws to be in the range 2.7-5.3 kg; the necessary total contact pressure should be about 0.8-1 kg/cm^2. Pins prevent the springs from moving.

During assembly, the folded washer and rotating contact bush are slipped onto the shaft. By screwing on the bush, the internal rings of the bearings are adjusted. To prevent unscrewing, the rotating contact bush is fixed by a folded washer and bolts. The remaining components of the seal are mounted in the seal cover and installed in the body of the reduction gear.

The rotating contact bush is prepared from steel 45, hardened to Rockwell C 55-65, and the fixed bush is made from bronze OS5-25. The contact bushes are carefully ground in. The design provides for lubrication of the contact surfaces by spiral lubrication channels (Fig. 4), cut into the fixed bush. Entrapment of oil in the enclosed spiral channel is effected and this involves the lubrication of the surface of the rotating steel contact bush. Centrifugal force throws off oil to the periphery, and thus an oil wedge is ensured at the contact surface.

The shaft of the reduction gear has a speed of rotation of 2300 rpm and the average peripheral speed of the surface of contact of the bushes is 14.5 m/sec.

Experience in the use of the described version of external open-sided contact seal at the Krivorozhsk metallurgical factory has indicated that there are practically no oil seepages (in laboratory conditions there are about 3-4 drops per hour). The wear on the bronze bush is 1.2 mm in 10,000 hr. The entire seal design was easily incorporated into an existing sealing unit without any alteration.

The wide use of contact seals in blast-furnace, rolling and other equipment in metallurgical factories in practice will almost entirely cut out losses of lubricating oil, will eliminate wear on the necks of shafts in the places where seals are installed, will cut out consumption of sealing packing and maintenance of seals during the use of machines and assemblies, and will also considerably increase the service life between the repair of equipment.

ELECTRONIC APPARATUS FOR AUTOMATICALLY CONTROLLING TUBE-ROLLING MILLS

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Special Planning and Construction Office of "Uralmontazhavtomatik" Combine
Translated from Metallurg, No. 9,
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The special planning and construction office of the "Uralmontazhavtomatik" combine in conjunction with the Pervoural'sk new tube factory has carried out the automation of tube-rolling installation 140 No. 3 with an automatic mill. For the first time, the difficult questions of the automation of long-travel pneumatic drives for thrust bearings and the automation of gripping installations have been solved on the basis of the electronic apparatus developed.

As a result of the automation of the installation, its productivity has been increased by 5-6%, and 12 operators have been released. In 1960 the control system for the long-travel pneumatic drive was also introduced into a similar installation at the Dnepropetrovsk tube-rolling factory. As a result, the time cycle in moving the thrust bearing was shortened by 2 sec, and this made it possible to increase the mill's productivity by 7-8%.

Long-travel pneumatic drives (7-10 m movement) are widely used for moving the thrust bearings of piercing and cross-rolling mills. Attempts which have been made in the past to automate such mechanisms did not lead to positive results. Replacement of pneumatic drives by electric drives, although simplifying the task of automation, at the same time reduces the installation's productivity, since in any particular instance with the same moving masses, electric drives are less rapidly acting, and are unreliable in their working (cables or chains frequently break).

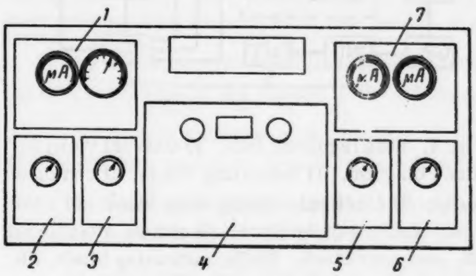

Fig. 1. General view of ÉRU assembly. 1) Measuring block; 2) electronic timing relay for return movement (ÉRVN); 3) fine return relay block RDN); 4) supply block; 5) fine forward relay block (RDV); 6) electronic timing relay for forward movement (ÉRVV); 7) channel block.

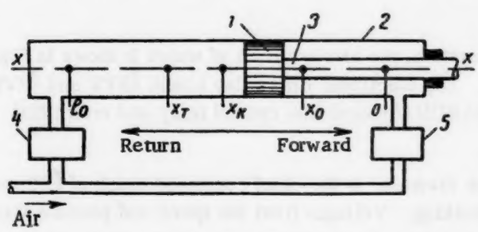

Fig. 2. Diagram of pneumatic drive. 1) Piston; 2) cylinder; 3) rod; 4 and 5) electropneumatic air distributors.

The difficulty of automating a long-travel pneumatic drive arose because of the large variations in the factors which influence its movement (air pressure in the main, friction of the bearing on the guides, the condition of the seals, the variable weight of the rod and so on). Despite this, a control system for a pneumatic guide should provide for precise stopping in the extreme positions, the rapidity of the action being as great as possible. It turns out to be possible to achieve the optimum pneumatic drive control only by the use of a specially developed electronic computer installation ÉRU (Fig. 1).

Let us examine the working of the control system by taking as an example the return travel of the piston. Air is fed into the right cavity of the pneumatic guide cylinder (Fig. 2) and the piston accelerates. At a certain point x_T the right cavity of the cylinder is connected to the atmosphere and air is fed into the left cylinder to provide deceleration by counter-pressure.

The coordinate of the point x_T is selected so that the piston should stop in the extreme position (point l_0), after which the left cavity is connected to the atmosphere. The coordinate of the point x_T in general varies and depends on the factors which influence the movement of the pneumatic guide.

The task of determining the coordinate of the point x_T for each travel of the piston is carried out by the computer units of ÉRU (electronic time relays with automatic control of the forward travel duration—ÉRVV—and return travel duration—ÉRVN). On the piston movement track a fixed coordinate point x_K is selected (control point). On the basis of the values

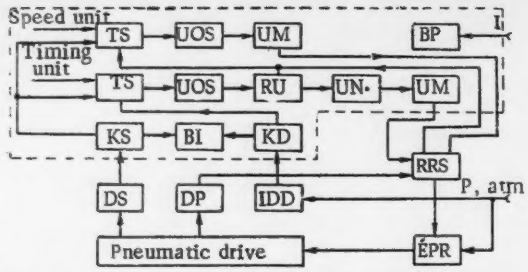

Fig. 3. Block circuit diagram for the automatic control system for a long-travel, pneumatic drive. TS, current integrater; UOS, amplifier with feedback; UM, power amplifier; RU, computer unit; UN, voltage amplifier; KS, speed channel; KD, pressure channel; BI, measuring block; BP, supply block; DS, speed transducer; DP, position transducers; IDD, inductive pressure transducer; RRS, distributors relay circuit; ÉPR, electropneumatic air distributors.

of air pressure in the main and piston speed, measured by transducers at the moment when the piston passes over this point, the computer blocks of ÉRU calculate the length of time at the end of which the piston will be at the point x_T where the command is given to decelerate.

The values of piston speed and air pressure in the main are continuously measured by the corresponding transducers and fed into ÉRU. A tachgenerator, caused to rotate by means of a rope drive or by a roller, friction driven from the pneumatic drive rod, forms the circuit's speed transducer.

As a pressure transducer, a standard instrument is used—a pressure drop transmitter type SPDS. The contact signal installation in it is replaced by a two-section ac coil connected in a bridge circuit. A core, rigidly connected with the bellows, moves inside the coil. The value of the voltage taken from the output of the bridge circuit is proportional to the movement of the core and thus to the air pressure in the main.

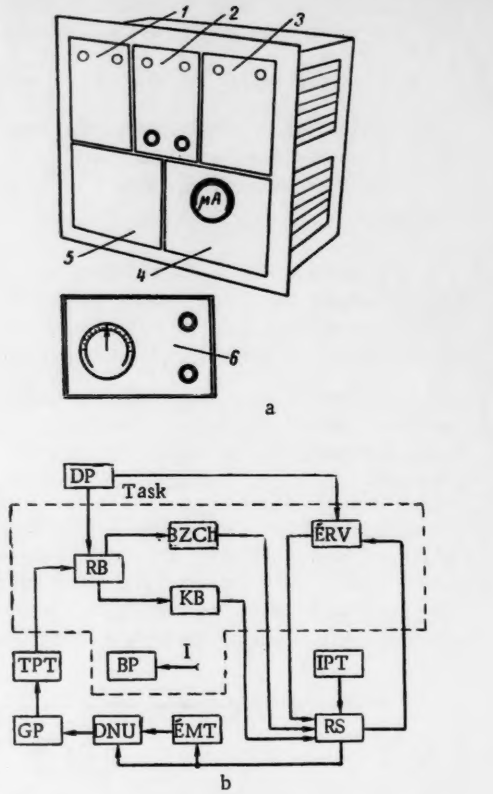

Fig. 4. Load regulator ÉRN. a) General view; b) block diagram. 1) Indicating block; 2) command block; 3) electronic timing relay block; 4) computer block; supply block; 6) remote attachment. BR, computer block; BZCh, indicating block, KB, command block; ÉRB, electronic timing relay block; BP, supply block; IPT, tube position indicator; RS, relay circuit; ÉMT, electromagnetic brake; DNU, motor of gripping installation; GP, main drive, TPT, DC transformer.

The transducers used in the control system for the position of the bearing (at points 0, x_k and l_0, Fig. 2) take the form of brush transducers which, when the bearing passes, close a contact on its housing, and relays, switched into circuit operate.

The information from all transducers is fed to the control system, the block-circuit of which is shown in Fig. 3. The ÉRU unit is outlined in the block circuit by the broken line. The electronic time relay blocks ÉRVV and ÉRVN (Fig. 1) are identical, as are also the fine control blocks RDV and RDN (forward fine control relay and return fine control relay).

The ÉRVV (ÉRVN) block—the middle line on the ÉRU block diagram—is the chief command block of ÉRU, and determines the moment to deliver the command at the start of braking. Voltages from the speed and pressure transducers and the setting voltage are supplied to the block's input, and these having been stores in the summator TS, are amplified by the amplifier UOS which charges the condenser of the computer unit RU. At the moment when the thrust bearing passes over the control point x_k, the condenser is cut off from the output of the amplifier UOS and

begins to discharge. When the condenser has finished discharging, the output relay of the ÉRVV (ÉRVN) block operates, and this switches over the pneumatic air distributor for braking.

The fine-control blocks RDV and RDN (Fig. 1) serve to control the movement of the thrust bearing as it approaches its extreme positions. They feed the command to stop braking when the speed of the bearing falls below a given value, determined by the setting of the blocks.

The fine control blocks ensure the accuracy required in stopping the bearing in the extreme positions.

As well as the blocks described, channel blocks form a part of ÉRU, which modify the voltages from the speed transducers (speed channel KS) and pressure transducer (pressure channel KD), and there is also a measuring block, which measures the voltages determining the setting and working of ÉRU. The ÉRU power supply is obtained from the supply block BP.

With air pressure variations in the pneumatic drive system in the limits 3.5-6.0 atm and with changes in friction, air-leakages, and so on that take place in practice, the time lapse can be varied in the range 0-0.5 sec: this corresponds to a change in the coordinate of the point x_T – the start of braking – in the range up to 2 m.

The rapidity of the pneumatic drive action has increased considerably with automatic control. Thus, for example, an automated thrust-bearing pneumatic drive on a piercing mill with a travel length of 7 m now has a movement cycle time of about 4 sec at a pressure of 5.5 atm: this compares with 6 sec or more with a corresponding automated electric drive or pneumatic drive with hand control.

Modernization of pneumatic drives was carried out during the automation: the 150 mm diameter cylinders were replaced by cylinder 180 mm in diameter.

To obtain the technologically required surface quality and geometrical dimensions of tubes in the process of rolling them in the cross-rolling mill, the reductions have to be regulated by the gripping installation so that a constant loading, laid down for each tube profile, is maintained on the motor of the main mill drive.

The electronic motor loading regulator ÉRN (Fig. 4) is the chief link in the system for automatically regulating tube reductions by the current to the rolling motor.

As a current indicator of the loading of the dc motor of the main drive, a dc transformer TPT is used The mechanism used is an asynchronous short-circuited electric motor of the gripping installation DNU.

The electronic timing relay block ÉRV gives the command to open up the rolls of the mill to a given value before rolling each tube to improve the way it is gripped.

As comparison tests have shown, the quality of the tube reduction regulation is better with automatic than with manual control.

Translated from Metallurg, No. 9,
p. 31, September, 1961

The Sverdlovsk publishing house has published a book by A. S. Osintsev entitled "Ferrous Metallurgy of the Urals," in which the problems of the growth of metallurgy in the Urals from the beginning of the eighteenth century until the present day are discussed.

The author gives a detailed historical survey of the growth of metallurgy in the Urals in the pre-revolutionary period. In this, a sound economic analysis is presented of the causes of the backwardness of Urals metallurgy in Tsarist times. In the book it is convincingly shown that "the Urals iron-making industry did not run down because of poor natural resources. The private form of ownership of land and mineral deposits maintained obstacles for the injection of capital into Urals metallurgy, and did not make it possible to carry out ore prospecting on a large scale."

In the chapter on the creation of the second metallurgical base in the USSR, the economic foundation is given of all the measures for the growth of metallurgy in the period of the country's industrialization.

In the fourth chapter "The New Upsurge," there are discussed methods and future prospects for further increasing the power of the raw material reserves of Urals metallurgy.

In discussing technical progress as the principal source of further growth of Urals metallurgy, the author presents interesting figures about the remarkable achievements of Urals metallurgists.

In the book much factual material is assembled about the economics of ferrous metallurgy in the Urals, and the photographs are well selected.

Unfortunately, inaccuracies and mistakes were found in reading the book; these could easily have been eliminated by more careful editing and compilation of the material. A few examples may be cited. On page 31 we read: "Mineralization of the fuel economy of Urals metallurgy began simultaneously with factory reconstruction." By mineralization is generally meant the process of converting existing natural products into minerals. The author of this book wrongly transfers the term to the economic field, and the reader must presume that here the discussion is about the change-over of Urals metallurgy from wood to mineral fuel.

In Table 8 on page 51 arithmetical mistakes are tolerated in figures about pig-iron production, and these are also repeated in Fig. 14 (page 52).

Similar mistakes are encountered on page 11 in Table 3, on page 115 in Table 12, and an inaccuracy on page 16 leads the author to a contradiction with his own conclusions. Frequent repetition of mistakes lowers the reader's confidence in the truth of the conclusions.

The author should have clarified in detail possible methods of expanding Urals metallurgy in the future, and should have indicated new ways of using Urals ores, new sources of raw materials and new methods for the metallurgical processing of ores, developed by scientific research institutes.

The author of a popular book ought to have indicated the leading part played by the Urals in developing the production strength of our country.

Despite the deficiencies that have been mentioned, A. S. Osintsev's book "Ferrous Metallurgy of the Urals" may be used as a textbook for economics seminars in studying the economics of ferrous metallurgy and may be useful to engineer-technical workers and workers in the leading metallurgical specialities.

B. Smirnov and G. Nichkova

MOVING FORWARD

G. V. Plechun

Department of Technical Information, "Dneprospetsstal'" Plant
Translated from Metallurg, No. 9,
pp. 32-33, September, 1961

Throughout the entire country there is a struggle for the prescheduled completion of the Seven-Year Plan —the plan for the construction of the technical and economic bases of Communism. The number of collectives contending for the right to be called a communist collective steadfastly increases.

At the "Dneprospetsstal'" Plant the first to win this coveted title was the collective of the No. 1 steelmaking shop. Great glory goes to the steelworkers of this united collective. One has but to enter the shop and the pulse of the life of labor, creativeness, is immediately felt. Outwardly it was as if nothing had changed in the shop. The steelworkers, mechanics, electricians, tappers, crane operators were the same as several years ago; they work at the same assemblies, make the same high-quality steel. But in their characters, work, and conduct there was much that was new and good. So therefore at these same furnaces they smelted so much more metal of a still better quality that by the 43rd anniversary of the Great October Revolution, five years earlier than the deadline, they have achieved the level of productivity planned for 1965, the last year of the Seven-Year Plan.

The shop collective is doing remarkable work in the third year of the Seven-Year Plan. Competing to celebrate appropriately the opening of the 22nd Congress of the Soviet Communist Party, the collective in the first quarter of 1961 fulfilled the plan for steelmaking by 104.9%, and the plan for delivery of suitable products by 103.9%.

The following facts attest to the wonderful work of the Shop of Communist Labor: during nine months of 1960 (before the collective was awarded the high title) rejects were 1.05%, and during four months of 1961 the losses of metal from rejects were reduced to 0.89%. During four months of the current year the shop reduced the cost of production by 1.43% and saved 248,600 tubles as well as many valuable materials: 146.9 t of nickel, 347 t of ferrochrome; and 72.9 t of ferrotungsten.

The steelworkers' brigades of Ivan Garbuz, Nikolay Minyailo, Ivan Reznichenko, Viktor Guzev, Petr Zadko, and many others are famed for their high productivity of labor in the shop. Having produced tens and hundreds of tons of metal in excess of the plan, they also achieved high quality indexes. Thus the brigades of N. Minyailo and P. Zadko reduced rejects to 0.01%, of S. Komashko to 0.04%, of V. Gruzev to 0.1%,etc.

The efficiency experts and inventors of the shop are carrying out great work. They actively participate in the organization and conduction of competitions. In the first quarter of 1961, 132 suggestions were submitted of which 43 have already been adopted with a savings of 20,800 rubles.

The chief of the charging yard, G. P. Parkhomenko, two years ago pledged to contribute to the Seven-Year Plan fund suggestions for better efficiency that would save 100,000 rubles. This leading worker did not go back on his word. During the two years he introduced a number of suggestions which have already saved more than 80,000 rubles.

Twenty-six suggestions for mechanizing production and lightening the labor of workers have been submitted and adopted by brigadeer of mechanics Kurinevskii, 14 by brigadeer of electricians Anpilogov. There are more than 20 adopted suggestions on the account of engineer V. Demidenko. The annual savings from these suggestions is 24,000 rubles.

The search for means to force the process of smelting in electric-arc furnaces led the shop efficiency experts to the thought of increasing the speed of the electrodes while automatically regulating the arc. This was accomplished by efficiency experts Demidenko, Peresetskii, and Adzerikho; they quadrupled the speed by replacing the single-cut worms with double-cut ones. By reducing the ratio of the reducing gears they retained the power of the existing electric motors and electrical equipment.

Reconstructions, which has been carried out at a number of shops, made it possible to reduce sharply nonproductive losses of time during smelting for changing the electrodes, dressing, charging, delivering the ferroalloys, and also to improve the power indexes of furnace operation: the heat losses were reduced, the duration of each melt was shortened on the average of 5-6 min, the specific consumption of power was reduced for each ton of steel by about 12 kw-hr.

The refractory lining of the electric steelmaking furnaces is worn out after a certain time and therefore cold repair to replace it must be done monthly. Not too long ago this was a laborious and onerous operation. The steelmakers had to break and remove the hot, burnt blocks and install new ones in their place. The lining was cooled incompletely and furnace repair had to be done at a high temperature for several hours.

The creative brigade of efficiency experts comprising engineers G. K. Smetanin, G. K. Klishkin, and A. E. Yurkovskii, and smelting foreman N. D. Lyubiv decided to accelerate making capital and cold repairs on the electric-arc furnaces and at the same time facilitate the working conditions of the steelmakers. A number of their suggestions were rejected. But the untiring innovators searched for newer ways, and the search was crowned with success. A new method was developed for high-speed repair by means of detachable frames for the furnace casing. The casing used is cut at the level of the banks; at the end of the furnace run the upper (removable) part of the casing with the burnt lining is removed by a crane, and in its place, immediately after repairing the banks, a new prelined spare upper part of the casing is installed and the water pipes of the cooling system connected. After this the furnace is again ready for operation.

First Brigade of Communist Labor of No. 1 steelmaking shop. In the picture (left to right): Third assistant F. M. Bezpal'ko, second assistant K. S. Voevodin, brigadeer V. D. Ivanchenko, first assistant I. M. Marchenko, control-board operator O. T. Uzunova. Photo by P. Kossy.

The new method cut several hours off time needed for repairs, considerably eased the labor of the steelmakers, and made it possible to increase production of steel by thousands of tons a year.

The experience accumulated by the steelworkers of the No. 1 shop made it possible to use successfully the detachable casing in other steelmaking shops and to save a total of 40,000 rubles.

Efficiency expert Demidenko was the initiator of a movement for the best care of equipment. As a result of the maximum reduction of downtimes of the assemblies and the excellent upkeep of the equipment, he suggested making capital repairs every two years instead of yearly, which would result in a savings of 100,000-150,000 rubles for capital repairs and a larger amount from the delivery of additional steel.

The first results are already in. Whereas before the downtimes of the equipment considerably exceeded the established norms, now they are below these norms. For example, the downtimes for four months of 1961 was 5.25% against the plan of 6.6%. The equipment of the shop has operated well without capital repairs for more than a year and a half and the shop has produced many additional tons of high-quality steel.

The "Dnepropetsstal'" Plant has done quite a bit to introduce new techniques and advanced technology, mechanization, and automation of the industrial processes.

The No. 1 steelmaking shop at the plant is called the school of innovators, the school of advanced labor methods, well schooled, and the laboratory of the adoption of new techniques and progressive technology. One of the foremost achievements in Soviet metallurgy is the method of molten-slag arcless electric remelting. Invented in the halls of the E. O. Paton Kiev Institute of Electric-Arc Welding and perfected by skilled plant workers, this method has made it possible to produce steel of exceptionally high quality which meets the present demands of industry. The steelmakers of the No. 1 shop, the workers and engineers, contributed to its introduction.

The No. 1 steelmaking shop has introduced a new method of vacuum processing steel, thanks to which it was possible to improve greatly the quality of the metal, to increase its strength and to achieve a considerable savings.

Such a labor-consuming operation as the delivery of oxygen to the furnaces was mechanized at the shop. Special water-cooled tuyeres which a steelworker controls from a special control panel were installed in the roof.

Having fulfilled organizational and technical measures, the steelmakers of the No. 1 shop will introduce modernized designs for automatic controls for moving the electrodes by using magnetic boosters and semiconductors. This should improve the process of regulating the power delivered to the furnace and increase the quality of steel. The problem of the stable regulation of the regime should be solved with the development and introduction of an automatic control for the furnace power, which has a hydraulic slave mechanism for the control system of the electrodes, and then automatic machines will maintain the furnace control panels.

The slogan "One for all and all for one" has become law in the life and work of the collective of the No. 1 shop, the Shop of Communist Labor. Many outstanding examples from the work-day of the collective can serve as proof of this slogan. The movement to render mutual aid began from scratch. The brigade for unloading nickel from the railway cars did not show up on the night shift, which threatened a standstill of the furnaces. Communist A. Amelin's brigade of mechanics came to the rescue and unloaded these cars. Soon powerful cranes delivered the nickel to the working areas of the furnaces.

Brigade of steelworkers of P. G. Stepenko. Left to right: First assistant I. G. Tikhonov, second assistant V. F. Kolomoets and P. G. Stepenko, third assistant N. T. Kozlov. Photo by P. Kossy.

Thus started the movement for rendering aid to each other. The Party Bureau and the trade union shop committee supported the undertakings of the innovators. Mutual assistance spread to many sections of the shop. The high discipline, strengthened by the strong workers' friendship and mutual assistance, permits the shop collective to advance steadfastly.

The steelworkers of the shop are solving great problems in the third year of the Seven-Year Plan in the matter of mastering the production of new types of high-quality steel, the improvement of its quality, and the reduction of the cost of production. In order to successfully solve these problems it is necessary to systematically increase the technical knowledge and qualifications of workers and engineers. For this purpose the shop has compiled a plan for the study and introduction of the experience of innovators. Reports were compiled in the first quarter according to which schools were organized and held for teaching the leading examples of the work of V. Guzev's brigade of steelmakers and V. Sevast'yanov's brigade of relief electricians.

A school was held from February 1 to March 15 to teach the experience of N. Minyailo's brigade of steelmakers, which systematically achieves a high productivity of labor and does not have rejects. More than 20 persons studied the examples of the innovators at this school.

The fulfillment of norms of those brigades attending classes increased from 108.4% to 113%, while rejects dropped from 0.34% to zero. Three more schools of steelmakers studying the experience of Minyailo's brigades have now been organized.

Seminars are to be conducted in order to increase the knowledge of the engineers. The Zaporozh'e Machine-Building Institute renders considerable aid for this purpose. The themes of the lectures and debates have also been worked out for political growth of the brigades of communist labor.

The feeling of collectivism grows in the Shop of Communist Labor, ever newer sprouts of what is new, what is to be, what is communistic are appearing. A struggle goes on for cleanliness and culture in production. Thursday has become a permanent "sanitation day" when after work the workers clean and put in order the shop and surrounding area.

Having stood the labor watch in honor of the 22nd Party Congress, the collective of the No. 1 steelmaking shop has pledged to produce ahead of schedule, by the opening day of the Congress, 4500 t of high-quality steel in excess of the plan and to save 2 million kw-hr of power.

We can say with certainly that the steelworkers of the shop will fulfill their pledges with honor and that the country will receive thousands of tons of steel over the plan by the day the Congress opens.

MECHANIZATION OF FURNACE REPAIRS AT THE "SERP I MOLOT" PLANT

L. A. Rakin, Deputy Chief of the Metallurgical Furnace Repair Shop and

P. A. Zorkin, Senior Engineer, "Serp i Molot" Plant

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The metallurgical furnace repair shop at our plant widely uses mechanized means when repairing assemblies. For example, in 1960-1961 movable monorail beams were installed in the No. 1 open-hearth shop to remove slag from the slag chambers of the open-hearth furnaces. Cleaning of the regenerators and checkers is accomplished by 7-meter long pneumatic portable conveyers having a belt width of 500 mm.

Since these mechanized facilities were introduced there has been no need for wheelbarrows, which were previously used for removing the slag, refuse, and breakage from the slag chambers and checkers of the open-hearth furnaces; in addition, this considerably improved the working conditions of those making repairs. The 500 mm conveyers are also used for collecting the refuse from the baths of the open-hearth furnaces, thus easing the labor load and reducing dustiness.

Considerable preparatory work is necessary before starting repairs on open-hearth furnaces. The furnaces, shutdown for repairs, are forcefully cooled by portable, high-pressure fans of the SVM-5 type with a capacity of 13,800 m^3 per hr and a VMD-450 fan with a capacity of 12,600 m^3/hr. The fans are installed as much as possible outside the shop so that the air intake is on the outside. The air is delivered to the open-hearth furnace along a corrugated metal hose 17-19 cm in diameter.

As soon as the temperature is reduced to a working level, dismantling begins. Fans are also used to blow on the masons, who demolish the furnace.

Until recently, assistant workers carried the mortar in buckets to the masons, but this was a very laborious operation. Presently the mortar is delivered to where the furnaces are being bricked by a mechanized pump which sends the mortar through a flexible hose. The pump can deliver mortar to any working section. Only one man is needed for this job.

The most labor-consuming job when preparing the furnaces for repairs is the delivery of refractory bricks to the repair site, and also their loading and unloading.

When the new warehouse for refractories was put into operation (1959), the refractory bricks for furnace repair were stored and transported in metal containers having collapsible sides and a carrying capacity of 1.5 t each and weight of 100 kg.

The warehouse was equipped with a charging workshop, two electric loaders with a lifting capacity of 1.5 t were acquired, and the manufacture of containers and bottom plates was organized in the repair and assembly shop.

To increase the pay load of the cranes when delivering refractory bricks to the shops, 24 metal plates were made, each of which holds four containers in two tiers. The refractory brick warehouse now has 1450 containers. Before this mechanization was introduced the refractory brick that arrived at the plant was unloaded exclusively by hand.

The "Serp i Molot" Plant has developed the following plan for loading, unloading and delivering refractory bricks to furnaces under repair. The brick is unloaded into containers which are delivered to railway cars by electric loaders. At the warehouse the loaded containers are stacked four to five tiers high, making possible the utilization of warehouse area to 5.5-6 t/m^2 for chrome magnesite brick (without taking into account the aisles).

The containers are loaded as needed onto railway platforms, where the plates are prepared beforehand, four to each platform. The refractory bricks delivered in containers to the units being repaired are not unloaded in any special manner at the furnaces; the containers which are released as the bricks are used are sent back to the platform and returned to the warehouse. Due to lack of metal containers, the plant uses wooden platforms and transports the brick in them in local cars, using electric loaders.

The present scheme for the storage and delivery of refractory bricks for furnace repairing made it possible to eliminate two manual reloadings of brick, which released eight workers. For example, 27 men were occupied in the loading and unloading operations in 1958 and 19 in 1961, including four drivers of electric loaders at the metallurgical furnace repair shop. The savings from this, at an average wage of 100 rubles, was 9600 rubles. The elimination of two hand reloadings made it possible to eliminate breakage of refractory bricks, which previously reached 1%.

Storage of bricks in containers has completely eliminated its shifting (previously up to 30% of the bricks were relocated). This reduced expenditures to 800 rubles.

The plant will soon receive refractory bricks from supply plants directly in containers. The first experimental party of Dinas bricks has already been received from the Pervoural' Dinas Plant in the containers of the "Serp i Molot" Plant. Now preparations are under way to receive ladle bricks from the Borovich Refractory Combine in metal containers of the "Serp i Molot" Plant. The experimental delivery of KhM-1 chrome magnesite brick and other types from refractory plants of the Ukraine will be organized.

The utilization of interplant transportation will yield a significant savings and completely eliminate heavy manual labor for loading and unloading, will reduce these operations at plants producing refractory bricks, and will considerably facilitate the work of the loaders.

The use of a number of organizational and technical measures at the plant during repair of metallurgical furnaces in 1960 alone made it possible to reduce the repair time on open-hearth furnaces by 3.5%, to improve appreciably the working conditions of the repairmen, and to lower industrial injuries in the metallurgical furnace repair shop during the last seven to eight years by a factor of 5.5.

LET US MOBILIZE ALL EFFORTS TO FULFILL THE PLEDGES TAKEN IN HONOR OF THE 22nd CONGRESS OF THE COMMUNIST PARTY OF THE SOVIET UNION

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The collectives at enterprises of the metallurgical industry in the Sverdlovsk Economic Administrative Region, having participated in the competition to greet appropriately the 22nd Party Congress, have taken on increased pledges with respect to the prescheduled fulfillment of the plan for the third year of the Seven-Year Plan; they have pledged to produce in excess of the plan by the day the Party Congress opens 36,000 t of pig iron, 27,000 t steel; 50,000 t rolled stock; 50,000 t of iron ore; 70,000 t of sinter; 9000 t of coke; 9000 t of refractories, to save 3 million rubles by lowering the cost of production, and to increase the productivity of labor by 0.7% in comparison with the plan.

Having developed a competition in honor of the 22nd Congress, the collectives at enterprises of ferrous metallurgy during the first quarter have fulfilled the plan for gross production by 103.3% and have produced in excess of the plan tens of thousands of tons of high-quality sinter, pig iron, steel, and rolled stock; the productivity of labor increased by 2% in comparison with the plan. The trade union committees of the enterprises have done great work to mobilize the workers for the prescheduled fulfillment of industrial plans in the third year of the Seven-Year Plan. A special seminar was held with the trade union workers of regional enterprises in order to propagate the experience of organizing competitions at the Severskii Metallurgical Plant and at the Nizhni Tagil Combine. The participants at the seminar were made aware of the system for summarizing daily the results of the competition which was used at the Sinarskii Tube Plant, of the experience of directing the work of permanent production conferences by the plant committee of the Verkh-Iseta Plant, and the work of the mass-production commission at the Pervoural' New Tube Plant.

The work of the permanent production conferences, scientific and technical societies, councils of inventors and efficiency experts, general design offices, and other organizations has become activated while preparing for the 22nd Congress. The collectives of 3345 brigades, 396 shifts, 230 sections, 27 assemblies, 178 shops and 11 enterprises are contending for the title of communist labor at enterprises of ferrous metallurgy. This honorable title has already been awarded to the collectives of 241 brigades, 11 shifts, 6 sections, 1 assembly, and 6 shops with 4758 workers.

The work of the best collective is widely disseminated. For example, reports are given over the plant and city broadcasting systems and in the plant and city newspapers at the Serov Combine, Verkh-Iseta Plant, Nizhni Tagil Combine, Severskii Metallurgical Plant, and at the Pervoural' and Sinarskii Tube Plants. Numerous colorful placards are displayed and special photographic exhibits, stands, and bulletin boards have been arranged.

The clubs and palaces of culture widely elucidate the progress of the socialist competition in honor of the 22nd Congress and thematic parties are held for the participants and their families.

In January the collective of the Verkh-Iseta Plant pledged to produce over the plan by the day the Congress opens 4500 t of steel and 2000 t of rolled stock. The creative activity of the masses is growing. A group of steelworkers at the plant headed by comrades Petukhov, Plekhanov, and others suggested to the metallurgists of the region that they produce thousands of tons of metal above the plan in honor of the 22nd Party Congress. The collective of one of the open-hearth furnaces at the V. I. Lenin Nizhni Tagil Metallurgical Combine suggested organizing a review of the technology of the metallurgical industry.

The collective of the Severskii Metallurgical Plant had the maximum use of internal production reserves and increased the output of products with the least expenditure of financial and material reserves. Comrades Koshkarov, Khlebnikov, and other forge-rolling operations of the Pervoural' Plant have proposed to master additionally the profession of mechanic and to make their own current repairs on the equipment.

This year 138 schools have been held at metallurgical enterprises to propagate the most advanced production methods; more than 3000 persons attended these schools. A school for hearth attendants at the Serov Combine was devoted to problems of improving the efficiency of using equipment and of increasing the productivity of labor. This promoted an increase in the efficiency of equipment utilization to 0.529 and of the productivity of labor to 104.2% against those previously attained of 0.554 and 103.2% respectively. A school for the most advanced experience with respect to the teeming of tire steel was held in the No. 2 open-hearth shop at the Nizhni Tagil Combine.

The general design offices have carried out many projects for automation and mechanization of industrial processes. Forty-five general design offices comprising 606 persons work at the Nizhni Tagil Combine. The general design offices of the 650-mill has manufactured an automatic device for marking tubular products, thus releasing eight men for other work. The general design office of the cogging mill solved the problem of removing slag, thus releasing 16 men. Twenty-three general design offices comprising 477 persons have been organized at the Pervoural' Tube Plant. In 1961 they developed 32 suggestions from efficiency experts, of which 25 have been introduced into production, with a savings of 47,807 rubles. Nineteen general design offices are working at the Severskii Plant and have worked out and introduced 34 suggestions.

Considerable assistance was rendered to the enterprises by the primary organizations of the Scientific and Technical Departments of the scientific research institutes in Sverdlovsk; they helped to expand the use of basic reserves, to develop new and to intensify the existing technological processes, to increase the qualifications of engineers and workers. The efficiency experts and inventors of the regional metallurgical industry submitted in the first quarter of this year more than 15,000 suggestions, of which more than 8000 have already been adopted.

However, there are still many serious shortcomings in the work. For example, the administrative enterprises of ferrous metallurgy in the Sverdlovsk economic region have not fulfilled the plan regarding cost of production, and during the first quarter of this year had over-expenditures totaling 3,066,000 rubles. The collective of the Nizhni Tagil Metallurgical Combine did not fulfill the first-quarter plan for gross production.

The administrative enterprises already have great losses from breakage (these amounted to 2,188,000 rubles in the first quarter), 1152 man-days were lost due to standstills and 5817 man-days due to loafing. The downtimes of the open-hearth furnaces during the first quarter of 1961 was 8.4% (in 1960 it was 7.3%).

To eliminate these shortcomings considerable aid must be rendered by the trade union committees and the economic advisors of the enterprises, by developing at each assembly, section, and shop the conditions needed to ensure fulfillment of the plan and pledges by all workers, to intensify the work to eliminate the present losses of workers' time and downtimes of the assemblies at the enterprises, and also to strengthen technological, productive, and labor discipline.

(From the results of the check made by the Central Committee of the Trade Union of Workers in the Metallurgical Industry concerning the progress of the fulfillment of the socialists pledged in honor of the 22nd Congress of the Communist Party of the Soviet Union.)

INCREASING THE PRODUCTIVITY OF LABOR OF THE REPAIR WORKERS

G. I. Shandrenko

All-Union Scientific Research Institute of Equipment for Ferrous Metallurgy
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The low level of the efficiency of workers who repair metallurgical plants is the result of the poor organization of repair methods at the enterprises.

Centralization and specialization of repairs and of the manufacture of spare parts, which can increase labor efficiency and reduce the number of repair workers, have still not received due development.

In 1960 the All-Union Scientific Research Institute of Equipment for Ferrous Metallurgy (VNIIOCherMet) worked out a standard regulation for the organization of repair operations at enterprises of ferrous metallurgy. The regulation called for the maximum centralization of repairs and intraplant specialization in the manufacture of spare parts; this regulation is for the transitional stage from centralization of repairs at individual enterprises to a more extensive form of centralization of repairs at a group of plants within economic administrative regions and republics.

In order to test and introduce this regulation, the VNIIOCherMet in 1960-1961 worked at the "Dneprospetsstal'" Plant to organize repair operations. As a result of this work the number of repairs workers per 1000 t of smelted electric steel was reduced from 1.5 to 1.2 men.

During 1961 the VNIIOCherMet is working at the Azerbaydzhan Tube Plant to introduce a standard system for organizing repair operations; the savings from its introduction will be even greater.

The elaboration and introduction of this regulation will solve the problem of creating more improved forms of organizing repair operations at the individual metallurgical plants; the problem of creating such forms for servicing a group of metallurgical plants within economic administrative regions and republics has still not been solved. On the basis of available material and design considerations in the departments of labor of economic administrative regions and in the planning institutes, and also on the basis of studying and generalizing the most advanced methods of enterprises in the USSR, in countries of people's democracy, and in the capitalist countries of Europe and America, it is necessary to work out the problem as to what must be done to develop repair operations at metallurgical enterprises on a scale as large as economic administrative regions and republics. The following alternative methods for organizing repair operations must be studied for this purpose.

1. The creation in the individual economic administrative regions and republics of independent trusts for repair of metallurgical equipment, furnaces, buildings, and structures, as well as of specialized bases for the manufacture of spare parts and replaceable equipment. Such a method for organizing repair operations was developed by the department of labor of the Stalino Economic Administrative Region and the Ukrainian State Planning and Design Institute for Metallurgical Plants in conjunction with the department of labor and the power and mechanical department of the Dnepropetrovsk Economic Administrative Region. It provides for the creation of repair administrations by merging shops and groups of metallurgical equipment repair plants with the construction administrations of the "Yuzhdomnaremont" Trust. Such repair administrations will be created in the Dnepropetrovsk Economic Administrative Region in the cities of Dnepropetrovsk, Dneprodzerzhinsk, and Krivoi Rog. The repair administration will be subordinated to the equipment repair trusts: to the "Donbassmetallurgremont" Trust in the Stalino Economic Administrative Region, to the "Mekhanoremont" and "Énergoremont" Trust in the Dnepropetrovsk region or directly to the directorate of the economic administrative region (the construction of several repair plants for each economic region is planned in order to assure spare parts for repairs).

The main shortcomings of this method are:

a) The liquidation of the "Yuzhdomnaremont" Trust, which for a number of years has successfully developed as a specialized organization for the repair of blast, steelmaking, soaking, and other furnaces and has successfully coped with this task;

b) the elimination of the services (when repairing metallurgical equipment) of the construction and assembly enterprises of the Ministry of Construction;

c) the low degree of specialization of repairs and the manufacture of spare parts since the plant calls for carrying out repairs of all mechanical equipment in the same trust; the manufacture of all spare parts is also planned for nonspecialized shops of the plants.

2. The organization within the "Yuzhdomnaremont" and "Yuzhkoksoremont" Trusts of specialized repair and assembly departments for the repair of metallurgical equipment of the blast-furnace, steelmaking, rolling, sintering, coke by-product, and other shops, and the construction of regional shops for the manufacture of spare parts. This method was developed by the metallurgical department of the Ukraine State Planning Office with the participation of the chief mechanics from most of the Ukrainian metallurgical plants.

3. The organization within the construction and assembly enterprises (Teplostroi, Metalurgmontazh, Prokatmontazh, Koksokhimmontazh, Koksoteplomontazh, etc.) of specialized repair and assembly departments for the repair of metallurgical equipment of blast-furnace, steelmaking, rolling, sintering, coke by-product, and other shops. This method was put forward while discussing the problem of the expediency of creating within the network of construction and assembly enterprises, repair and assembly departments in the immediate vicinity of the metallurgical enterprises, the more so since during installation of new equipment and during its repair most labor operations are identical when carrying out mechanical and assembly operations. In addition the presence of repair and assembly departments at the construction and assembly enterprises will ensure the best use of labor.

The development and introduction of improved forms of the organization of repair operations will considerably increase the efficiency of repair workers.

CONSTRUCTION OF A METALLURGICAL COMBINE IN BULGARIA

I. D. Vikhrev

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In 1959 the People's Republic of Bulgaria produced 149,000 tons of rolled product. This satisfied only 21% of the country's needs. The fact that production of ferrous metals was so far behind the required, necessitated the construction of a metallurgical combine with a capacity of one million tons/ yr of rolled stock, whereby the latter would produce a rather wide range of sizes and types of products.

The design, construction and installation of most of the pieces of equipment is at present under way with the help of the Soviet Union. The raw material base for this combine is being provided by the Kremikovtsi deposit which is located 20 km to the North East of the City of Sofia. Proven reserves of this deposit stand at 246.9 million tons of categories A and B and C and have an average iron content of 30%. In addition the ore contains 6.8% manganese, about 18% barium sulfate, and 0.4-0.6% lead.

The combine will consist of the following: an open-pit mine with a capacity of 5 million ton/yr of iron ore; a blast-furnace plant consisting of two 1033 m^3 furnaces with a total capacity of 1,120,000 tons/ yr; a steel melting shop of 1,265,000 tons/ yr, of which 1,135,000 tons/ yr will be produced in converters and 130,000 in an electric furnace; there will be three converters of 100 ton capacity, operating on oxygen and one 100-ton electric furnace. The rolling mills will have a total capacity of one million tons and will include: hot rolling mills comprising a type 1150 blooming mill of 1,265,000 tons/ yr ingot capacity; a continuous, type 700/ 500 billet mill; a continuous, type 250 fine wire-rod mill, and a semicontinuous type 1700 strip mill with a capacity of 531,000 tons/ yr of coils. Cold rolling mills will have a capacity of 503,000 tons/ yr and will produce 280,000 tons/ yr of cold-rolled sheet of various sorts and 223,000 of pickled and heat treated strip. (For these mills the following is being planned: a continuous pickling strand, a rolling and trimming department consisting of two reversible cold-rolling strands of type 1200 and 1700 and one trimming strand of type 1700; an electrolytic-cleaning, annealing, clipping and sorting department, electrolytic and hot-dip tinning strands and lacquering facilities; and a galvanizing department equipped for continuous galvanizing.) A pipe mill and bent-shapes shop will have an automated strand for producing 50,000 tons/ yr of seamless pipe; also a type 20-102 plant for electrically welded pipe which will include a strand for hot reduction and drawing of pipe; capacity will be 50,000 tons/ yr of welded gas pipe produced from skelp. There will be a shape mill of the type 1-4 × 50-400 for the production of 30,000 tons/ yr of bent and irregular shapes made from strip; also a 30-ton three-set cold drawing strand for the production of cold-drawn tubing and a plant for hot dip galvanizing of gas pipe which will have an automated material-flow system and equipment for electrolytic galvanizing of couplings. The refractories plant with a capacity of 12,400 tons/ yr of pitch-containing dolomite brick for lining of converters and 14,300 tons/ yr of mortars, powders and masses (clay, fines, magnesite and chromomagnesite products will be brought in from the outside; demand for these is estimated to be 30,000 tons/ yr). The lime-dolomite plant will have a capacity of 250,000 tons/ yr of lime and 18,000 burnt dolomite; there will be four 60 m long rotary kilns. Scrap handling facilities will have a capacity of 250,000 tons/ yr of unsorted scrap. Repair shops will consist of: a forge shop capable of handling 3500 tons of forgings, a metallic construction shop for 6000 tons and a machine shop for 8000 tons of finished articles, and repair shops for handling current maintenance of blast furnaces, steel shops and rolling mills. In addition there will be slag treatment and ferroalloy plants.

It is planned that the following finished products will be turned out by the combine per year: 100,000 tons of small gauge rolled stock; 250,000 tons of wire rod; 150,000 tons of hot-rolled strip, up to 1500 mm, in the form of rolls or sheets; 90,000 tons of cold rolled strip of same width, also in rolls and sheets; 50,000 tons of white tin plate; 60,000 tons of galvanized sheet; 20,000 tons of generator steel; 10,000 tons of transformer steel; 40,000 tons of skelp of width up to 300 mm; 30,000 tons of bent shapes; 50,000 tons of welded pipe, 20-102 mm in diameter; 50,000 tons of seamless pipe; 38-140 mm in diameter. It is foreseen that 100,000 tons/ yr of semifinished blooms and slabs will also be produced.

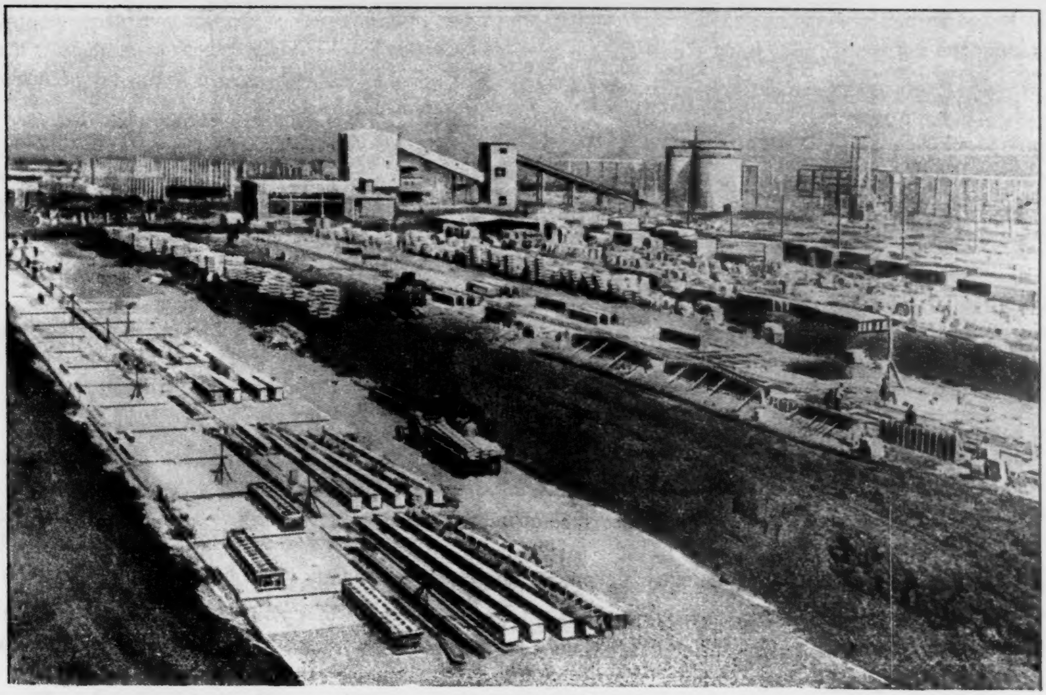

Fig. 1. General view of the material and equipment supply depot at the combine.

The beneficiating plant is based on a combination flow-sheet. There will be magnetizing roasting and flotation and products will be as follows: 2.5 million tons of iron concentrate containing 48.8% iron, 748,000 tons of barium concentrate with 85% barium sulfate, and 66,000 tons of mangasene concentrate containing 27% manganese.

The preparation of concentrates for smelting will be by agglomeration: for this purpose a plant with a capacity of 2.5 million tons/yr of prefluxed pellets has been designed. The latter will contain 48.72% iron, 11.5% manganese

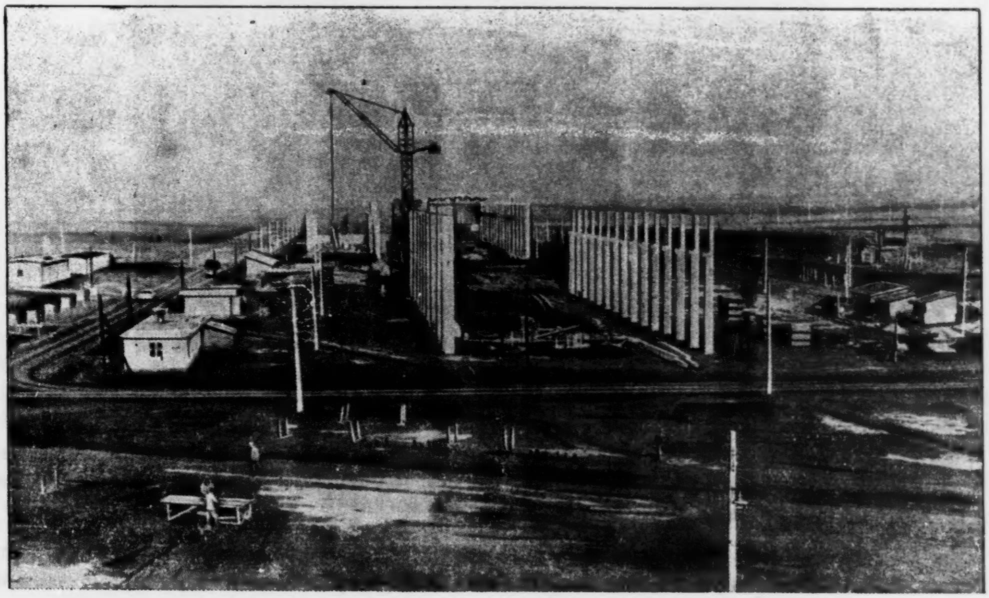

Fig. 2. Construction of a group of maintenance shops.

Fig. 3. The open-pit mine. Progress of overburden-removal work.

oxide, 3.67% barium oxide and 0.08% tin oxide. According to the design capacity of the beneficiating plants, the deposit's life will be about 50 years.

Metallurgical coke requirements have been estimated at 748,000 tons/ yr on a dry basis. To meet this demand a coke-chemical complex is being constructed consisting of two coke batteries with 69 furnaces in each having a total capacity of 785,000 tons/ yr of dry coke, out of which 707,000 tons will be metallurgical-grade coke. The deficiency of 40-50,000 tons will be met by bringing coke in from outside or shortening the designed coking period..

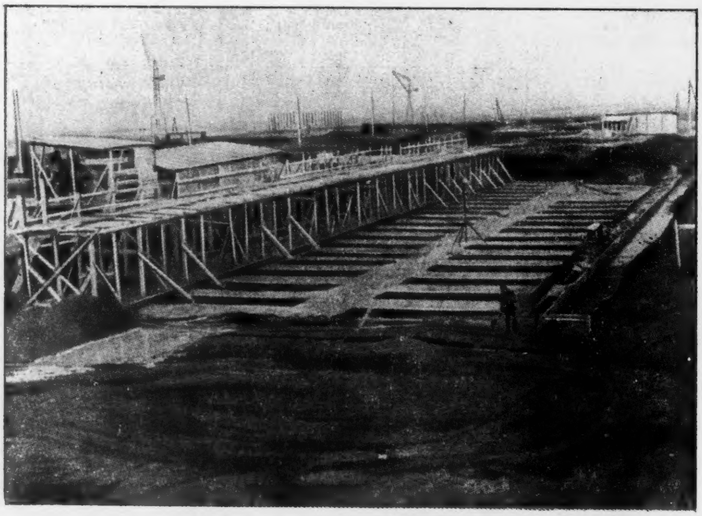

Fig. 4. Laying the foundations of the No. 1 coke-battery.

It is planned to bring into production in 1962 the following units: the open-pit mine with an annual tonnage of 1.5-2 million, the pelletizing plant with 1.5 million tons of pellets one blast furnace and coke-oven battery, and the first stage of the "T.É.Ts" (power plant) yielding 31,000 kw.

In the second half of 1960 construction of the following was begun: two concrete plants, a reinforced-concrete shop, an inert materials stockpile, an armature shop, a wood-working shop, a boiler house, stores, a construction-

machinery repair shop and others. In the second and third quarters of the current year much of the machinery required to equip these shops is expected to arrive from the USSR and it should be possible to have this equipment in operation by the end of this year.

In 1961 the construction of the following units was begun: the main body of the "T.É.Ts.-P.V.S," including the open-air and enclosed distribution systems, fuel handling, water filtration and softening. At the coke-chemical plant under construction are the refractory storage sheds, quenching tower and the coal preparation shop. Excavation and filling work is underway at the coke-chemical plant, maintenance shops, "T.É.Ts," where 2 million m^3 of earth have been moved. Under construction are railway tracks and roads to the blast furnace area, the coke-chemical plants and maintenance shops.

It is planned to start operations in the metal construction and forge shops during the third quarter of the current year and during the first half of 1962, in the foundry and the machine shop. In the beginning of 1961 the ore hauling rail road from three mine levels was put into operation. At present the mine substation and overhead electrical net are under construction. The plans are to start up the electrically powered hauling mechinery at the mine.

At the combine 23 km of track have been completed. This trackage is connected with the net operated by the Ministry of Communications. Under construction are the restaurant, change house and living quarters. In June,1961 the number of workers on the combine site reached 8000. In order to start up the first blast furnace late in 1962 or in the first quarter of 1963, 1800 million leva* must be invested in 1962. From this sum 900-1,000 million leva must be in the construction and erection phases.

At present the progress of construction is held back by the absence of construction materials, primarily facilities for producing concrete and reinforced concrete. Production facilities for these are awaiting installation of equipment. A series of local concrete facilities are under construction which should provide 700 m^3 of concrete per day, already during May to June.

Construction Cost* Estimate for the Combine (in leva)

	Estimated cost at the Kremikovtsi combine	Actual cost at the Lenin Works	Release cost
Coke	459	545	480
Pellets	130	–	–
Sinter	–	240	–
Pig iron	570-625	1204	800
Steel ingot	977	1310	–
Shape steel and wire rod	1747	1946	1650-1870
Hot rolled strip	1562	–	1700-2500
Cold rolled strip	2001	–	2280-2700

In the nearby villages of Kremikovtsi, Botunets,and others,living quarters for 3400 construction workers have been either newly constructed or converted from existing buildings. In addition 2100 workers live in the city of Sofia and other nearby localities. In the village of Botunets and near the material and equipment storage depots, mess halls for 1500 people per change have been constructed. In the maintenance-shops region another mess hall with room for 600 people per change and another smaller mess in the village of Kremikovtsi have been built. In Botunets construction of a bath house with 60 compartments will be started in the second quarter of this year. Change houses, volley-ball courts and a club have been completed.

*100 leva is equivalent to 13.23 rubles (as of July, 1961).

Of considerable importance at the moment is the completion of the designs for the underground and above-ground water and power facilities net, which will connect all shops and mills. It is important that construction of this net is begun during the second quarter of 1961 otherwise it will interfere with the progress of structural construction. This in turn will increase the cost of construction and will make completion of some of the facilities difficult.

The general contractor for the construction of the metallurgical combine is the only design and construction organization ("E.S.M.O.") which is in charge of all construction and erection work.

Justification for the construction of the new combine is based on the cost data shown in the table. From this data it is seen that the estimated production cost at the Kremikovtsi combine is lower than the actual production cost at the Lenin Works and lower than the country's release costs.

Construction of the combine in complete accordance with the plans will ensure that the country's economy is supplied with metal in needed quantity and form for the coming years. The outstanding need of metal in the country can be satisfied by utilizing the existing reserves to raising the production rate to 20-2.5 million tons of rolled stock per year. There is a need to intensify exploration work to discover new iron-ore and coking-coal resources and also to calculate the country's demand for ferrous metals for a longer time in the future. Based on this, the rate of growth of the country's ferrous metallurgy would be determined, and, to begin with, the production rate at the Kremikovtsi Combine would be increased.

Soviet Journals Available in Cover-to-Cover Translation

ABBREVIATION	RUSSIAN TITLE		TITLE OF TRANSLATION	PUBLISHER	TRANSLATION BEGAN Vol.	Issue	Year
AÉ	Atomnaya énergiya		Soviet Journal of Atomic Energy	Consultants Bureau	1	1	1956
Akust. zh.	Akusticheskii zhurnal		Soviet Physics – Acoustics	American Institute of Physics	1	1	1955
	Antibiotiki		Antibiotics	Consultants Bureau	4	1	1959
Astr(on). zh(urn).	Astronomicheskii zhurnal		Soviet Astronomy—AJ	American Institute of Physics	34	1	1957
Avto(mat). svarka	Avtomaticheskaya svarka		Automatic Welding	British Welding Research Association (London)		1	1959
	Avtomatika i Telemekhanika		Automation and Remote Control	Instrument Society of America	27	1	1956
	Biofizika		Biophysics	National Institutes of Health*		1	1957
	Biokhimiya		Biochemistry	Consultants Bureau	21	1	1956
Byull. éksp(erim). biol. i med.	Byulleten' éksperimental'noi biologii i meditsiny		Bulletin of Experimental Biology and Medicine	Consultants Bureau	41	1	1959
DAN (SSSR) Dokl(ady) AN SSSR	Doklady Akademii Nauk SSSR		The translation of this journal is published in sections, as follows:				
		Life Sciences	Doklady Biochemistry Section	American Institute of Biological Sciences	106	1	1956
		Life Sciences	Doklady Biological Sciences Sections (Includes: Anatomy, biophysics, cytology, ecology, embryology, endocrinology, evolutionary morphology, genetics, histology, hydrobiology microbiology, morphology, parasitology, physiology, zoology sections)	American Institute of Biological Sciences	112	1	1957
		Life Sciences	Doklady Botanical Sciences Sections (Includes: Botany, phytopathology, plant anatomy, plant ecology, plant embryology, plant physiology, plant morphology sections)	American Institute of Biological Sciences	112	1	1957
		Chemical Sciences	Proceedings of the Academy of Sciences of the USSR, Section: Chemical Technology	Consultants Bureau	106	1	1956
		Chemical Sciences	Proceedings of the Academy of Sciences of the USSR, Section: Chemistry	Consultants Bureau	106	1	1956
		Chemical Sciences	Proceedings of the Academy of Sciences of the USSR, Section: Physical Chemistry	Consultants Bureau	112	1	1957
		Earth Sciences	Doklady Earth Sciences Sections (Includes: Geochemistry, geology, geophysics, hydrogeology, mineralogy, paleontology, petrography, permafrost sections)	American Geological Institute	124	1	1959
		Earth Sciences	Proceedings of the Academy of Sciences of the USSR, Section: Geochemistry	Consultants Bureau	106-123	1 6	1957-1958
		Earth Sciences	Proceedings of the Academy of Sciences of the USSR, Sections: Geology	Consultants Bureau	106-123	1 6	1957-1958
		Mathematics	Doklady Soviet Mathematics	The American Mathematics Society	131	1	1961
		Physics	Soviet Physics—Doklady (Includes: Aerodynamics, astronomy, crystallography, cybernetics and control theory, electrical engineering, energetics, fluid mechanics, heat engineering, hydraulics, mathematical physics, mechanics, physics, technical physics, theory of elasticity sections)	American Institute of Physics	106	1	1956
		Physics	Proceedings of the Academy of Sciences of the USSR, Applied Physics Sections (does not include mathematical physics or physics sections)	Consultants Bureau	106-117	1	1956-1957
Derevoobrabat. prom-st'.	Derevoobrabatyvayushchaya promyshlennost'		Wood Processing Industry	Timber Development Association (London)		9	1959
	Élecktrosvyaz		Telecommunications	Massachusetts Institute of Technology*		1	1957
Éntom(ol). oboz(renie)	Éntomologicheskoe obozrenie		Entomological Review	American Institute of Biological Sciences	38	1	1959
Farmakol. (i) toksikol(ogiya)	Farmakologiya i toksikologiya		Pharmacology and Toxicology	Consultants Bureau	20	1	1957
FMM	Fizika metallov i metallovedenie		Physics of Metals and Metallography	Acta Metallurgica*	5	1	1957
Fiziol. zhurn. SSSR (im. Sechenova)	Fiziologicheskii zhurnal im. I. M. Sechenova		Sechenov Physiological Journal USSR	National Institutes of Health*		1	1957
Fiziol(ogiya) rast.	Fiziologiya rastenii		Plant Physiology	American Institute of Biological Sciences	4	1	1957
	Geokhimiya		Geochemistry	The Geochemical Society		1	1958
FTT	Fizika tverdogo tela		Soviet Physics—Solid State	American Institute of Physics	1	1	1959
Izmerit. tekh(nika)	Izmeritel'naya tekhnika		Measurement Techniques	Instrument Society of America		1	1959
Izv. AN SSSR, O(td). Kh(im). N(auk)	Izvestiya Akademii Nauk SSSR: Otdelenie khimicheskikh nauk		Bulletin of the Academy of Sciences of the USSR: Division of Chemical Sciences	Consultants Bureau		1	1952

continued

Izv. AN SSSR, O(td). T(ekhn). N(auk): Met(all). i top.	(see Met. i top.)					
Izv. AN SSSR Ser. fiz(ich).	Izvestiya Akademii Nauk SSSR: Seriya fizicheskaya	Bulletin of the Academy of Sciences of the USSR: Physical Series	Columbia Technical Translations		1	1954
Izv. AN SSSR Ser. geofiz.	Izvestiya Akademii Nauk SSSR: Seriya geofizicheskaya	Bulletin (Izvestiya) of the Academy of Sciences USSR: Geophysics Series	American Geophysical Union		1	1954
Izv. AN SSSR Ser. geol.	Izvestiya Akademii Nauk SSSR: Seriya geologicheskaya	Izvestiya of the Academy of Sciences of the USSR: Geologic Series	American Geological Institute		1	1958
Kauch. i rez.	Kauchuk i rezina	Soviet Rubber Technology	Research Association of British Rubber Manufacturers	18	1	1959
	Kinetika i kataliz	Kinetics and Catalysis	Consultants Bureau	1	3	1960
	Koks i khimiya	Coke and Chemistry USSR	Coal Tar Research Association (Leeds, England)		1	1958
Kolloidn. zh(urn).	Kolloidnyi zhurnal	Colloid Journal	Consultants Bureau	14	1	1952
	Kristallografiya	Soviet Physics – Crystallography	American Institute of Physics	2	1	1957
Metalov. i term. obrabot. metal.	Metallovedenie i termicheskaya obrabotka metallov	Metal Science and Heat Treatment of Metals	Acta Metallurgica	6	1	1958
	Metallurg	Metallurgist	Acta Metallurgica		1	1957
Met. i top.	Metallurgiya i topliva	Russian Metallurgy and Fuels	Eagle Technical Publications		1	1960
Mikrobiol.	Mikrobiologiya	Microbiology	American Institute of Biological Sciences	26	1	1957
OS	Optika i spektroskopiya	Optics and Spectroscopy	American Institute of Physics		6	1959
	Pochvovedenie	Soviet Soil Science	American Institute of Biological Sciences		1	1958
	Priborostroenie	Instrument Construction	British Scientific Instrument Research Association		1	1959
Pribory i tekhn. éks(perimenta)	Pribory i tekhnika éksperimenta	Instruments and Experimental Techniques	Instrument Society of America		1	1957
Prikl. matem. i mekh.	Prikladnaya matematika i mekhanika	Applied Mathematics and Mechanics	American Society of Mechanical Engineers		1	1958
PTÉ	(see Pribory i tekhn. éks.)					
	Problemy Severa	Problems of the North	National Research Council of Canada			
Radiotekh.	Radiotekhnika	Radio Engineering	Massachusetts Institute of Technology*	12	1	1957
Radiotekh. i élektronika	Radiotekhnika i élektronika	Radio Engineering and Electronics	Massachusetts Institute of Technology*	2	1	1957
	Stanki i instrument	Machines and Tooling	Production Engineering Research Assoc.		1	1959
	Stal'	Stal (In English)	Iron and Steel Institute		1	1959
Stek. i keram.	Steklo i keramika	Glass and Ceramics	Consultants Bureau	13	1	1956
Svaroch. proiz-vo	Svarochnoe proizvodstvo	Welding Production	British Welding Research Association		4	1959
Teor. veroyat. i prim.	Teoriya veroyatnostei i ee primenenie	Theory of Probability and Its Applications	Society for Industrial and Applied Mathematics		1	1956
Tsvet. Metally	Tsvetnye metally	Nonferrous Metals	Primary Sources		1	1960
UFN	Uspekhi fizicheskikh Nauk	Soviet Physics – Uspekhi (partial translation)	American Institute of Physics	66	1	1958
UKh	Uspekhi khimii	Russian Chemical Reviews	The Chemical Society (London)		1	1960
UMN	Uspekhi matematicheskikh nauk	Russian Mathematical Surveys	London Mathematical Society	15	1	1960
Usp. fiz. nauk	(see UFN)					
Usp. khim(ii)	(see UKh)					
Usp. matem. nauk	(see UMN)					
Usp. sovr. biol.	Uspekhi sovremennoi biologii	Russian Review of Biology	Oliver and Boyd		48	1959
Vest. mashinostroeniya	Vestnik mashinostroeniya	Russian Engineering Journal	Production Engineering Research Assoc.		4	1959
Vop. gem. i per. krovi	Voprosy gematologii i perelivaniya krovi	Problems of Hematology and Blood Transfusion	National Institutes of Health*		1	1957
Vop. onk.	Voprosy onkologii	Problems of Oncology	National Institutes of Health*		1	1957
Vop. virusol.	Voprosy virusologii	Problems of Virology	National Institutes of Health*		1	1957
Zav(odsk). lab(oratoriya)	Zavodskaya laboratoriya	Industrial Laboratory	Instrument Society of America	25	1	1959
ZhAKh Zh. anal(it). khimii	Zhurnal analiticheskoi khimii	Journal of Analytical Chemistry USSR	Consultants Bureau	7	1	1952
ZhETF Zh. éksperim. i teor. fiz.	Zhurnal éksperimental'noi i theoreticheskoi fiziki	Soviet Physics–JETP	American Institute of Physics	28	1	1955
ZhFKh Zh. fiz. khimii	Zhurnal fizicheskoi khimii	Russian Journal of Physical Chemistry	The Chemical Society (London)		7	1959
ZhMÉI Zh(urn). mikrobiol. épidemiol. i immunobiol.	Zhurnal mikrobiologii, épidemiologii i immunobiologii	Journal of Microbiology, Epidemiology and Immunobiology	National Institutes of Health*		1	1957
ZhNKh Zh(urn). neorgan(ich). khim(ii)	Zhurnal neorganicheskoi khimii	The Russian Journal of Inorganic Chemistry	The Chemical Society (London)		1	1959
ZhOKh Zh(urn). obshch(ei) khimii	Zhurnal obshchei khimii	Journal of General Chemistry USSR	Consultants Bureau	19	1	1949
ZhPKh Zh(urn). prikl. khimii	Zhurnal prikladnoi khimii	Journal of Applied Chemistry USSR	Consultants Bureau	23	1	1950
ZhSKh Zh(urn). strukt. khimii	Zhurnal strukturnoi khimii	Journal of Structural Chemistry	Consultants Bureau	1	1	1960
ZhTF Zh(urn). tekhn. fiz.	Zhurnal teknicheskoi fiziki	Soviet Physics–Technical Physics	American Institute of Physics	26	1	1956
Zh(urn). vyssh. nervn. deyat. (im. Pavlova)	Zhurnal vysshei nervnoi deyatel'nosti (im. I. P. Pavlova)	Pavlov Journal of Higher Nervous Activity	National Institutes of Health*		1	1958

*Sponsoring organization. Translation through 1960 issues is a publication of Pergamon Press.

SIGNIFICANCE OF ABBREVIATIONS MOST FREQUENTLY ENCOUNTERED IN SOVIET PERIODICALS

FIAN	Phys. Inst. Acad. Sci. USSR.
GDI	Water Power Inst.
GITI	State Sci.-Tech. Press
GITTL	State Tech. and Theor. Lit. Press
GONTI	State United Sci.-Tech. Press
Gosénergoizdat	State Power Engr. Press
Goskhimizdat	State Chem. Press
GOST	All-Union State Standard
GTTI	State Tech. and Theor. Lit. Press
IL	Foreign Lit. Press
ISN (Izd. Sov. Nauk)	Soviet Science Press
Izd. AN SSSR	Acad. Sci. USSR Press
Izd. MGU	Moscow State Univ. Press
LÉIIZhT	Leningrad Power Inst. of Railroad Engineering
LÉT	Leningrad Elec. Engr. School
LÉTI	Leningrad Electrotechnical Inst.
LÉTIIZhT	Leningrad Electrical Engineering Research Inst. of Railroad Engr.
Mashgiz	State Sci.-Tech. Press for Machine Construction Lit.
MÉP	Ministry of Electrotechnical Industry
MÉS	Ministry of Electrical Power Plants
MÉSÉP	Ministry of Electrical Power Plants and the Electrical Industry
MGU	Moscow State Univ.
MKhTi	Moscow Inst. Chem. Tech.
MOPI	Moscow Regional Pedagogical Inst.
MSP	Ministry of Industrial Construction
NII ZVUKSZAPIOI	Scientific Research Inst. of Sound Recording
NIKFI	Sci. Inst. of Modern Motion Picture Photography
ONTI	United Sci.-Tech. Press
OTI	Division of Technical Information
OTN	Div. Tech. Sci.
Stroiizdat	Construction Press
TOÉ	Association of Power Engineers
TsKTI	Central Research Inst. for Boilers and Turbines
TsNIÉL	Central Scientific Research Elec. Engr. Lab.
TsNIÉL-MÉS	Central Scientific Research Elec. Engr. Lab.-Ministry of Electric Power Plants
TsVTI	Central Office of Economic Information
UF	Ural Branch
VIÉSKh	All-Union Inst. of Rural Elec. Power Stations
VNIIM	All-Union Scientific Research Inst. of Meteorology
VNIIZhDT	All-Union Scientific Research Inst. of Railroad Engineering
VTI	All-Union Thermotech. Inst.
VZÉI	All-Union Power Correspondence Inst.

Note: Abbreviations not on this list and not explained in the translation have been transliterated, no further information about their significance being available to us - Publisher.